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**THE ROLE OF INDIGENOUS KNOWLEDGE IN BIODIVERSITY
CONSERVATION: IMPLICATIONS FOR CONSERVATION
EDUCATION IN PAPUA NEW GUINEA**

A thesis submitted in partial fulfilment of the
requirements for the degree of

Master of Science

by

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ABSTRACT

The research reported in this thesis focussed on exploring existing indigenous environmental knowledge of two indigenous communities in Papua New Guinea and how this knowledge was acquired, interpreted and disseminated to the next generation. The relevance of indigenous environmental knowledge in the promotion of biodiversity conservation efforts was investigated.

This research was conducted within an interpretive paradigm. A naturalistic/ethnographic methodology was used. Data was collected through semi structured interviews and observations. Participants in this case study were representatives of the community and included elders, adults, teachers and students.

The findings in this study revealed indigenous environmental knowledge as useful for biodiversity conservation and promotes sustainable practices. It showed that indigenous family knowledge is essential for claiming land inheritance and indigenous environmental practices are consistent with sustainable practices and land use. Forest knowledge is found to be useful in identifying and locating resources and that sustainable practices ensured continuity of these resources. The study also identified spiritual knowledge and beliefs as fundamental for developing indigenous worldviews and environmental attitudes and values and that change in resource use may be both beneficial and harmful to biodiversity.

The findings also revealed indigenous education as flexible, holistic and informal in nature and uses mostly oral history through verbal instruction and various non-verbal means. They showed that IE uses a variety of teaching and learning approaches that utilise the environment as a tool and that learning venues provide a realistic learning experience.

The thesis concludes that IEK promotes biodiversity conservation in many ways and that indigenous education uses situated context to promote realistic learning. Indigenous environmental knowledge and education could therefore be used in biodiversity conservation education.

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INTRODUCTION

1.1 Introduction

Papua New Guinea (PNG) is thought to harbour more than five percent of the world's biodiversity of which 789 species are endemic, 41 percent of which are considered threatened and 6 percent classified as endangered (Sekhran & Miller, 1995). The existence of this biodiversity is mostly linked to the country's rich ecosystems which support the nation's primary resource-based economy. It is also essential for providing goods and services and creating ecological stability necessary for maintaining the resilience of the biosphere (ibid). Increasing threats to these rich ecosystems and their biodiversity is a cause for concern because of widespread environmental degradation. Deterioration of basic life support is imminent at the cost of future generations if no measures are taken to conserve biodiversity. Sekhran and Miller also argue that clearing of PNG's forests may enhance the effects of climate change and greenhouse effect as the forests serve as a massive carbon sink.

Moreover, the differences in the level of well being of people, aggravated by uneven distribution of economic growth, has resulted in an increased demand for exploitative development activities to meet changing lifestyles. These demands may override sustainable limitations of the natural environment when renewable resources are over used. With the rate of population growth high at 2.7 percent, this gives cause for concern. The challenge for the decades ahead is to ensure that there is a balance between development to meet human needs and biodiversity conservation. Considerations should be given to the possibility of integrating development with biodiversity conservation objectives.

This notion of integrating conservation and development initiatives is not new to PNG as these initiatives have been in existence in the early 1980s as Integrated Conservation and Development Projects (ICAD). The ICAD initiatives attempt to

encourage eco-enterprise activities that sustainably use forest resources to generate income and at the same time manage resources to promote biodiversity conservation. Conservation organisations have in the past two decades worked with respective indigenous communities to implement these initiatives. The difficulty with such initiatives is being able to know what different parties want and attempting to strike a balance between the two. Often, conservation practitioners have limited knowledge about the environmental perceptions and practices of the local people and their value in biodiversity conservation. A common tool used by many conservation organisations in Papua New Guinea to promote conservation initiatives is education and awareness.

My experience in working with a non-government conservation organisation as a conservation educator in the past six years is that conservation practitioners often have no prior knowledge of the local people's environmental perceptions and practices. Practitioners are ill prepared to work with local communities and attempts to promote biodiversity conservation have often encountered difficulties. This is echoed by Orsak (2005, p.5) who wrote that "conservation messages won't be captured or remembered, much less applied, if they aren't relevant to people's everyday life and concerns". An understanding of indigenous people's prior knowledge is essential to make biodiversity conservation more meaningful.

1.2 Aim of Study

It is the aim of this study to explore indigenous environmental knowledge and practices, both past and present, among indigenous Papua New Guinean societies, to identify different education approaches and processes they have used to acquire, interpret and pass on environmental knowledge that contribute to the conservation of their fauna and flora. The study also aims to use the findings to guide conservation education initiatives in Papua New Guinea.

1.3 Research Questions

The questions that I have used to guide this study are:

1. What indigenous environmental knowledge is important for biodiversity conservation in two villages in Papua New Guinea and what fundamental beliefs inform these knowledge systems? Do the two village cultures share the same views on these knowledge systems? If not, how and why are they different?
2. How are these indigenous environmental knowledge systems acquired, interpreted and passed on in the two cultures? What tools aid the acquisition, interpretation and dissemination of these knowledge systems?

1.4 Significance of the research

This research is significant because it offers another perspective to biodiversity conservation. It gives information on how indigenous environmental knowledge can be incorporated into conservation education programs to make biodiversity conservation efforts more meaningful.

The information from this study can also benefit teachers in the planning and teaching of their environmental studies lessons. It will also benefit conservation education initiatives in Papua New Guinea on the whole in that it can guide planning and implementation of conservation education program activities.

1.5 Thesis Overview

This thesis is organised into five chapters.

Chapter One introduces the aim and purpose of the research, details the research questions, and provides the research background and the thesis overview.

Chapter Two provides background on Papua New Guinea relating to its biodiversity and history of conservation education. A review of the literature in relation to

biodiversity conservation, indigenous knowledge and indigenous education is then presented.

Chapter Three details the theoretical framework of the study and the research methods used. It explains the case study research design including the data analysis and addresses quality issues.

Chapter Four presents the research findings. Each key theme derived from the research questions is analysed in detail.

Chapter Five discusses the research findings, analyses the themes in chapter four and considers the implications of the research in biodiversity conservation and conservation education.

LITERATURE REVIEW

2.1 Chapter overview

This chapter documents a summary of the literature that underpins the importance of biodiversity conservation and conservation education efforts both in Papua New Guinea and elsewhere. It also reviews literature concerning indigenous knowledge, particularly regarding the environment and indigenous education.

2.2 Background of Papua New Guinea

Papua New Guinea (PNG) is part of the Oceania group of islands and occupies the eastern half of the large tropical island of New Guinea and its associated off-shore islands between the Coral Sea and the South Pacific Ocean, east of Indonesia (see map Figure 2.1). The eastern half of the island of New Guinea – the second largest island in the world - was divided between Germany (north) and the United Kingdom (south) in 1885. The latter was transferred to Australia in 1902, which occupied the northern portion during World War I and continued to administer the combined areas until independence in 1975.

The country of PNG is characterised by extremely high local relief with most of the land surface covered by tropical forest, except some coastal areas and valleys in the highlands. The total land area is about 462,860 km² which is mostly mountainous with coastal lowlands and rolling foothills. The population was estimated to be about 5.9 million in 2005 with an annual growth rate of 2.7 per cent. Although there are 800 plus languages spoken by the diverse cultures of PNG, there are three official languages - English, Pidgin and Motu.

Although cultures vary widely, the traditional PNG social structures are generally based on the practice of a subsistence economy and bonds of kinship with

obligations extending beyond the immediate family. There is also a strong attachment of the people to land, which is held communally. Papua New Guineans have a strong adherence to traditional social structure which is the basis of village life and most are drawn towards this way of life.

Figure 2.1: Map of Papua New Guinea



Source: CIA Fact book

2.2.1 Land tenure and ownership

The natural environment, to a large extent, is still very important to rural Papua New Guinea (PNG) communities as about 87 per cent of people living in rural areas depend on it for their livelihood. This dependence is also illustrated by the fact that 97 per cent of the nation's total land mass, including almost all forests (Lynch & Marat, 1993) is owned by the local people. These customary land rights are also recognised by the constitution of PNG. Like other Melanesians, land ownership in PNG is owned by kinship groups but used by individuals or households. These groups usually consist of clans to which membership is recruited mainly by descent, either patrilineal or matrilineal (Fingleton, 1993).

2.2.2 Environmental status

Large areas in PNG are still in pristine condition (Sekhran & Miller, 1995), and have little or no human disturbances. This condition is mainly attributed to low population densities and use of low impact technologies by the rural communities (ibid). The ruggedness of the terrain also makes many areas inaccessible leaving them undisturbed.

2.2.3 Environmental Policies and Acts

PNG has a well developed set of conservation and environment protection laws, dating back to pre-independence in 1975 (Fingleton, 1993). These laws were only applicable to particular aspects of the environment such as fauna protection and water resources and were used to declare national parks. A scheme of legislation introduced in 1978 took a more comprehensive approach to environment protection as it was consistent with the ethos of PNG projected by the National Goals and Directive Principles contained in PNG's 1975 Constitution. The particular aspects of the National Goals that provide direction for establishing this body of laws is the fourth Goal on Natural resources and environment. This goal aspires "for Papua New Guinea's natural resources and environment to be conserved and used for the collective benefit of us all and to be replenished for the benefit of future generations" (Fingleton, 1993, p.33). The various Acts introduced in response to this include the Environmental Planning Act 1978, Environment Contaminants Act 1978, and Conservation Areas Act 1978.

2.3 Environment and Conservation in Papua New Guinea

The environment, which consists of the living and non living as well as the natural and the physical attributes, is a treasured commodity for most Papua New Guineans (PNG). It is the lifeline of rural communities since it provides their basic necessities including food, medicine, building materials and clothing. The importance of the

environment is recognised by the National Constitution of PNG in the declaration of its Fourth Goal to conserve and replenish the environment and its resources for the benefit of the current and future generations (Fingleton, 1993). Types of environments found in PNG include terrestrial, freshwater, marine and estuarine which consist of various ecosystems such as mountain glaciers, humid tropical forests, swampy wetlands and pristine coral reefs. The significance of these environments is brought to another level as mounting pressure of environmental degradation intensifies throughout the country. Issues of environmental protection and biodiversity conservation have attracted greater interest as alternative approaches are explored by all those concerned to prevent further deterioration. It is at this stage that conservation of the variety of living organisms and their habitats takes precedence.

2.3.1 Biodiversity conservation in Papua New Guinea

Biodiversity conservation in Papua New Guinea (PNG) has become a major concern due to habitat destruction caused by increased farming and grazing activities, shifting cultivation practices, village expansions due to increased population, and large scale logging and other extractive activities such as mining. These activities have resulted in the loss of huge forested areas which are home to various fauna and flora species, some of which may have disappeared without ever being discovered. As reported by the Brundtland Report (1987, p.148) “biologically rich ecosystems are severely threatened while vast stocks of biological diversity are in danger of disappearing”. This scenario is quite relevant to PNG with the increasing trend of habitat destruction caused by logging and mining activities. It is assumed that a huge number of undiscovered species are disappearing with the loss of these habitats.

Efforts to study PNG’s fauna and flora have greatly increased with a number of international conservation organisations taking the lead in administering scientific studies. These studies range from forest ecology and demography to ornithology and entomology (Wright, 2003) as well as very specific studies such as Opiang’s (2004) on the home range, movement and den use in long beaked echidnas

(*Zaglossus bartonii*) and another study by Hamilton (2004) on the Melanesian Island pteropodidae (*Chiroptera*) community niche partitioning conveyed in hair and tongue ecomorphology. These studies provide useful information about the ecology of species which are not known otherwise.

A significant issue of concern in biodiversity conservation research is the presence of indigenous people who inhabit these study areas, their impact on the local fauna and flora; and, their indigenous environmental knowledge necessary for sustainable management of resources. The issues pertaining to indigenous people are quite tricky as conservationist need to consider their interactions with the environment and how information about the impact of these interactions on biodiversity can be made known to them. It is therefore vital to understand what biodiversity conservation is about before venturing into indigenous communities to administer conservation practices.

2.3.2 Definitions

The term biodiversity is the shortened form for biological diversity and is defined in various ways depending on the users' agenda. According to Hambler (2004, p.11) biodiversity is "the variety of life". This is a very short and broad definition based on the definitions of the terms biology and diversity. Other definitions are quite elaborate and consider the organisms in their complexities such as Dobson (1996, p.10), who describes it as the "variety and variability among living organisms and the ecological complexes in which they occur". The definition by the Convention on Biological Diversity (CBD) states that it is "the variability among living organisms from all sources, including amongst others, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems" (Hambler 2004, p.11) while Redford and Richter (1999, p.1247) define it as the "natural variety and variability among living organisms, the ecological complexes in which they naturally occur and the ways in which they interact with each other and with the natural environment". The above definitions not only consider the variety but also the variability among the species which are often quite enormous and the

interactions between the species within the ecosystems they exist in. Another definition of biodiversity that considers the genetic variability of the organisms is one by O’Riordan & Stoll-Kleemann (2002, p.9) which states that it is the “variety of living organisms on Earth, the range of species, and the genetic variability within each species, and the varied characteristics of ecosystems”. Despite the variation in the definitions, the common features that are consistent are the variety and variability among species and their ecosystems which are vital for species survival. In my view, the use of the term biodiversity considers the living organism holistically and includes the diverse forms of life; the differences in variability within the different forms of life; the ecosystems within which they exist and their interactions within species, with other species and their environment. Thus the definition by Redford & Richter (1999) is relevant for the purpose of this thesis.

Conservation, on the other hand, is also defined in various ways with some terms being widely used in these definitions. Theodore Roosevelt (Hambler, 2004, p.2) defined conservation as the “wise use of resources”. This definition is broad and may not appear to consider other useful features such as the human impact. Other definitions provide a wider scope of the use of the term and consider features that are deemed essential for the benefit of humans and the world at large. For example, the Concise Oxford Dictionary (1990, p.244), defines conservation as “preservation, especially of the natural environment” while Encyclopaedia Britannica (2007, 1) defines it as “the planned management of a natural resource or the total environment of a particular ecosystem to prevent exploitation, pollution, destruction, or neglect and to ensure the future use of the resource”. This is consistent with the World Conservation Strategy (IUCN) of 1980’s definition that conservation is “the management of human use of the biosphere so that it may yield the greatest sustainable benefit to the present generation while maintaining its potential to meet the needs and aspirations of future generations”(Hambler, 2004, p.2). The above definitions highlight the importance of conservation in the preservation and management of natural resources and consider ecosystems and nature in its totality. Hambler (2004) on the other hand, defines it as the “protection of wildlife from irreversible harm”. In this context, Hambler’s definition aims to portray conservation as a protection of non-domestic species and populations of

plants, micro-organisms and animals against changes that are not reversible within a human generation and danger or declines due to people.

For the purpose of this thesis, I will define conservation as the management of wildlife and other natural resources. Biodiversity conservation is therefore the sustainable management of wildlife and other natural resources and the complex ecosystems in which they exist.

2.3.3 Significance of biodiversity conservation

O’Riordan and Stoll-Kleemann (2002, p.21) described biodiversity as both “an ecological and a social phenomenon because it contains properties which are of cultural, intellectual, aesthetic and spiritual values that are important to society”. The social aspects of biodiversity bring a whole new perspective that draws away from the traditional view that biodiversity is totally scientific. The emphasis of the Brundtland Report (1987) on the importance of species and their genetic materials and their vital contributions to agriculture, medicine and industry highlight the important role of biodiversity in development. Equally important is its ability to “stabilise climate, protect watershed and soil and provide nurseries and breeding grounds”(Brundtland 1987, p.147) for various species. Moreover, Beattie (1995, p.9) suggest that because “biodiversity is beautiful, it is the functional foundation of civilisation and it harbours an array of resources beneficial to life” it must be conserved. He also argue that the above reasons substantiate the need to conserve biodiversity at all levels including gene, species and ecosystem; and exploring and incorporating the potentials of biodiversity to improve quality of life using biodiversity based goods and services. Moreover, Ismail and Mohamed (1998) added that biodiversity forms the basis for all sustainability as different levels of biodiversity are essential in various life supporting endeavours from agriculture to medicine. These reasons signify the importance of biodiversity and the need for its conservation.

Overwhelming support to promote biodiversity conservation efforts had also been evident in the financial support provided by various individuals and institutions for

the purpose of research and establishment of protected areas to conserve nature (Ismail & Mohamed, 1998; O'Riordan & Stoll-Kleemann, 2002; Eaton 2005). With the high increase in the extinction of anthropogenic species (Sakar, 1999), both those that are recognised by the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) and “those that are culturally symbolic” (O'Riordan & Stoll-Kleemann, 2002, p.9), it meant that measures were urgently needed to rectify the situation. Establishment of protected and conservation areas were a measure taken by scientists, governments, communities and various conventions in an attempt to conserve biodiversity.

While establishments of protected and conservation areas have become popular worldwide, issues pertaining to these areas are still pertinent (Sinclair et al., 2000; Barrett et al., 2001). The question of who should make the decisions for biodiversity conservation or, where biodiversity conservation should occur, require sufficient planning and research to determine what will and will not work. Sinclair et al. (2000) argue that legislated protected areas will not automatically save biodiversity because it is not the sole solution. Instead Sinclair et al. suggest that a multi approach should be taken that is directed at addressing social and economic issues of the communities involved and provide “long term commitments that support long range planning and permanent positions” (2000, p.37). This approach is favourable towards community based conservation strategy which promotes sustainable development in areas where people live. Barrett et al. (2001) added that effective protected or conservation area management is vital for their sustainability and greater commitment of financial and technical assistance are required both at national and international levels to administer effective coordination of biodiversity conservation projects. Therefore, while the establishment of protected and conservation areas are worthwhile, they may not be the complete solutions to biodiversity conservation efforts. Nevertheless, much effort had been put into their establishments in the hope of enhancing biodiversity conservation.

2.3.4 Papua New Guinea situation

As a country, Papua New Guinea was a signatory to a number of international

conventions including CITES of 1973 and Convention on Biological Diversity (CBD) of 1992. The principal objective of the latter is the “conservation and sustainable use of biodiversity and the equitable sharing of the benefits from the use of biodiversity goods and services between users and resource holders” (Sekhran & Miller, 1995, p.2). The Convention also binds signatories to cooperate in providing financial and other support for conservation, with developed countries providing financial assistance to enable developing countries to achieve the objective of the Convention. This approach has been the basis of conservation efforts in PNG whereby a number of national and international NGOs have been established in PNG with financial support from overseas donors and agencies to fund project activities.

Being a signatory also meant that PNG had to take action to ensure that the objectives and purposes of the conventions were adhered to. A conservation needs assessment was done for PNG and following this a biodiversity country study was conducted. The establishment of protected areas in the country was also widespread in response to this and some examples of these protected areas include Variarata National Park in the Central Province and Mt Gahavisuka Provincial Park in the Eastern Highlands Province. National parks established in PNG were based on the Yellowstone National Park model in USA (O'Riordan & Stoll-Kleemann, 2002) which restricts the use of the park and prevents access by local people. However, the establishment of National Parks during the 1980s did not work very well due to many factors because unlike the USA, the land and resources in PNG is owned by the local people and to exclude them without any alternative for their subsistence lifestyle was problematic. In contrast, the conservation area concept introduced in the late 1980s, was more favourable to the local people because it laid down few restrictions and allowed local people to have access to the area as long as they practice sustainable use of resources. In addition, the approach involved the local people in the planning and management as well as the ownership of the conservation area with some assistance from the government agencies and NGOs as and when required. The question then would be how local people are informed about the reasons and benefits of conservation and what their roles and obligations are as people within the protected or conservation areas. I believe this is where

conservation education programs become a useful vehicle to promote awareness and education among the local people.

2.3.5 Conservation Education in Papua New Guinea

Conservation education programs have been set up by various conservation organisations working in PNG to promote awareness and education among the local people on the importance of biodiversity conservation and its relationship to human survival. I have worked as a conservation educator for six years with one such non-government conservation organisation (NGO), the Research and Conservation Foundation (RCF) of PNG, whose sole purpose is to promote biodiversity conservation through its projects. To achieve its goal, RCF attempts to promote and preserve the unique flora and fauna for the benefit of the people of PNG and the world; and, encourage, finance, assist in, and undertake research into the flora and fauna of PNG, and to co-operate with institutions and persons with similar aims (RCF Mission statement). With an enormous task like this, RCF could not be able to achieve all this on its own and has to work in partnership with other institutions and persons with similar interests.

As conservation practitioners, RCF has encountered many difficulties in working with local communities who have a social and cultural obligation to protect their natural resources and at the same time are pressured to provide for other family needs such as health and education. With the communities being rural and needing much needed health and other services, they view RCF and other similar conservation organisations as surrogate government departments in that not only are such organisations promoting biodiversity conservation work but they are also expected to provide government services. Such demands are problematic for conservation organisations as they need to clarify their roles to the local people and make this known to the communities they are involved in. It is at such crucial points that conservation education becomes a vital tool to create the much needed awareness about the work of the organisations as well as promoting the efforts of biodiversity conservation. Moreover, it is also the role of the conservation education programs to educate the local communities on the importance of the environment

and its biodiversity.

Conservation education is a form of environmental education that had its origins in zoos and aquariums. According to the American Zoo and Aquarium Association (2006), conservation education is a powerful tool for connecting people to nature. Educators in the zoo and aquarium settings use the exhibits of animals and their habitats to reach out to students, visitors and the general public with messages of biodiversity conservation. Such efforts are said to be ex-situ as they promote conservation of species in a non natural setting. Ex-situ conservation is not practicable in PNG as it does not have well established zoos and aquariums. The PNG context is more suitable for in-situ conservation because species are mostly in their natural habitats and efforts are made to conserve both the species and their habitats.

Most conservation education programs in PNG are designed and implemented by conservation organisations, both government and non government. Orsak (2005) describes early conservation education efforts in PNG as dominated by the government Department of Environment and Conservation where field officers took advantage of field projects to give conservation talks to rural communities. These conservation talks were done using movies and videos as well as printed materials like posters and leaflets. It was not until the 1990s that non governmental conservation organisations became heavily involved in conservation education. The way each conservation education program is designed is dependent on the organisation, its goals and objectives and the availability of resources in terms of personnel and finance. Generally, most conservation education programs implemented in conservation areas aim at educating the local resource owners on the importance of their natural resources and particularly to promote education and awareness of any threatened or endangered species within the conservation area. One aspect of the community conservation education programs that is often ignored or failed to be recognised by many conservation practitioners is the existence of local indigenous knowledge. This knowledge could prove to be useful in biodiversity conservation. Ideas about indigenous knowledge in relation to the

environment are reviewed in the following section.

2.4 Indigenous knowledge

Interests in the studies of indigenous knowledge (IK) have increased in the past decades its significance in sustainable development was made known by the Brundtland Report, *Our Common Future* (1987) and the Earth Summit in Rio de Janeiro in 1992. It is also incorporated in the *Agenda 21* documents of the United Nations (UNESCO, 2006) and the International Convention on Biodiversity. Triggered by this recognition, increasing numbers of governments, non governmental organisations, international conventions and other institutions and individuals became interested in promoting the subject for one reason or another over the past decade. The following sections attempt to explain what IK is and how it relates to environmental knowledge and values.

Like Traditional Ecological Knowledge (TEK), IK has emerged from the growing recognition that “indigenous peoples around the world can effectively contribute to addressing global environmental problems” (McGregor, 2004, p.385) using their environmental knowledge which has enabled them to sustainably live in harmony with the natural world over thousands of years. The Brundtland Report of 1987 played a leading role in recognising the importance of the role of indigenous people in sustainable development and five years later, the Convention on Biological Diversity (CBD) reiterated the same in achieving sustainable environmental and resource management. With the support from international conventions and reports on the use of IK, a number of studies have been done to date on the subject. Two examples are, an anthropological study by Ellis and West (2004) on Local History as Indigenous Knowledge conducted in the Crater Mountains of PNG and another study by Campbell (2004) on Indigenous Views on the terms of participation in the development of Biodiversity Conservation in Nepal. Both of these studies are anthropological in nature but attempt to show how IK can be incorporated to understand developmental issues from the indigenous perspectives. For development and conservation practitioners working among indigenous societies, it is vital to understand the local knowledge and how this can be utilised to one's

advantage. In the following subsections, I have attempted to define IK and show that it is actually indigenous environmental knowledge (IEK) because IK has developed from indigenous people's experiences and observations of the environment.

2.4.1 Defining IK

The term Indigenous Knowledge (IK), is used interchangeably with Traditional Ecological Knowledge (TEK), Local Knowledge (LK) and Indigenous Environmental Knowledge (IEK), and may be defined in various ways. According to Altieri (1990 in Verlinden & Dayot, 2005, p.144), IK is the "accumulated knowledge, skills and technology of local people derived from their direct interaction with the environment" while Bicker et. al. (2004, p.107) defined it as "the local knowledge that is unique to a given culture or society and is often focused on people's relationship with the natural world". A similar definition of TEK is given by Fikret Berkes (in Corsiglia & Snively, 1997, p.22), as "a cumulative body of knowledge and beliefs, handed down through generations by cultural transmission about the relationships of living beings (including humans) with one another and with their environment". The definitions by Altieri, Bicker et al. and Berkes highlight the importance of the development of IK from people's relationship with nature and this I believe is the basis of IK. The term local knowledge however, is defined as "any knowledge held collectively by a population, informing understanding of the world" (Sillitoe et al., 2002, p.39). Although the above definitions are varied, two things are conspicuous. Firstly, the body of knowledge is accumulated over time and secondly, the knowledge is developed from the relationships of the people with their environment.

The above points underpin the view that IK has developed over many generations and is based on people's interactions with their environment (Corsiglia & Snively, 1997; Antone, 2003; Bicker et al., 2004; McGregor, 2004; Verlinden & Dayot, 2005), thus any studies investigating IK must firstly consider the people involved in the formation of this knowledge system. In highlighting this view, McGregor (2004, p.388) argues that "defining IK may restrict its true meanings and portray it as uniform which is not true because indigenous people differ from each other and

what would be acceptable in one part of the world may not be so in another part”. She also added that IK cannot be separated from the people who hold and practice it to be codified into a definition, as it should always be considered holistically and not partially. McGregor also adds that IK can however be conceptualised as “the expression of the vibrant relationships between people, their ecosystems, and other living beings and spirits that share their lands, which are all interrelated and cannot be separated from the traditional territories of the people concerned”. While I agree with McGregor that IK cannot be separated from the people who possess it, I do also believe that it is vital to provide a definition of IK to guide any further research and understanding of the subject. Thus, I have attempted to define IK as the accumulated knowledge and skills of indigenous people and their relationship with the environment.

The question of how useful IK is cannot be contemplated in one statement as it requires thorough research on the subject to identify various ways IK has benefited different groups and individuals who have used it or attempted to use it. Various studies on the usefulness of IK have been carried out by researchers such as the study on IK and management of *Araucaria araucana* forests in the Chilean Andes by Herrmann (2006) which demonstrated the importance of IK in native forest management. The knowledge and skills of the Mapuche Pewenche people of the southern Chilean Andes contributed to the sustainable management of the *Araucaria araucana*. Another example is demonstrated by the indigenous knowledge of the Nguni of eastern southern Africa about a type of cattle disease that enabled this group of people to protect their cattle from the disease by getting rid of the wildlife within the vicinity of the cattle feeding areas (O'Donoghue, 2003). It was years later that scientific research proved the existence of a microscopic trypanosome in the wildlife that affected healthy cattle.

The view that “traditional conservation and indigenous knowledge have always been in co-existence” (Eaton, 2005, p.10) is vital for development and conservation practitioners, particularly for those in the developing countries like PNG, where 87 percent of the population are subsistence dwellers and are still dependent on the environment for their sustenance. With increased appreciation of various forms of

IK and practices today, the opportunities for improved conservation and development programs will increase their efforts to educate and create awareness among the locals. Thus there is the need to integrate these indigenous knowledge base concepts to provide greater insight and understanding in conservation education in PNG.

As IK is knowledge that is wholly indigenous and owned by the people who created it, it had to have originated from some source to have a greater impact on the people who use it. Indigenous peoples developed their IK from their experiences and observations of the environment, thus IK is directly linked to the environment and hence, by nature it is indigenous environmental knowledge (IEK). Since IK has its origin in the environment, it is notable to revisit IEK and how this has an influence over indigenous peoples' environmental attitudes and values.

2.4.2 Indigenous environmental knowledge systems

Indigenous environmental knowledge (IEK) drew from the view that knowledge accumulated over generations by indigenous peoples is based on their interactions and experiences with their environment and is referred to as the “accumulated body of knowledge of the remaining indigenous groups in the world which represents a body of ancient thought, experience and action that must be honoured and preserved as a vital storehouse of environmental wisdom” (McGregor, 2004, p.388).

Indigenous environmental knowledge (IEK) is varied and reflects respective groups of indigenous people and their world views. Worldview is defined by Kawagley et al. (1998) as “a comprehensive, especially personal, philosophy or conception of the world and of human life”. Unlike the Western worldview that nature must be studied, dissected and mastered and progress measured by the ability to extract secrets and wealth from the earth, indigenous people do not consider the land as merely an economic resource (Fien, 2002). Their ancestral lands are literally the source of life, and their divergent ways of life are developed and defined in relationship to the environment around them. It is these experiences that trigger their worldviews.

To understand IEK, it is vital to revisit the indigenous worldviews and how particular indigenous peoples viewed the natural world and life that co-existed with it. For example, the Pacific peoples who share the great Pacific Ocean as their home are of three descents – Melanesia, Micronesia and Polynesia. The Melanesians occupy the western side of east Pacific Ocean that includes Papua New Guinea, Solomon Island, Vanuatu, New Caledonia and Fiji. The Micronesians occupy the Northern part of the Pacific and include the Federated State of Micronesia, Kiribati, Marshall Islands and Palau while the Polynesians occupy the central and southern Pacific Ocean and include New Zealand, Cook Islands, Tonga, Samoa, and Tuvalu. Despite these groups of people living very close to each other, there are differences in their world views that stem from the differences in their knowledge systems.

According to Narakobi (1980, p.6), “the Melanesian people of PNG view the world in its totality whereby there is cosmic harmony between the human person, the spirit world as well as the plant and animal world”. This human person does not perceive him/herself as the absolute master of the universe but as an important component of an interdependent world and believes that even trees, rocks and other natural life had souls and entities to which life can be attributed. The human person learns and understands the ways of nature through silent observation of the natural world and thus uses the power of silent language. This occurs when a person interprets what one hears and sees things around them with less verbal communication. A similar worldview is shared by the Micronesians who recognise spirits beings as existing in their own accord and are associated with special crafts and activities (Alkire, 1977). Every form of practice is associated with these spirits and an offence committed to the spirits brought sickness and death. The Polynesian on the other hand, “conceive their universe as being made up of certain elements, among which are the heavens, the world of humans, and the underworld” (Craig, 2004, p.51). The Polynesians believe that creation followed a genealogical order that began in the far distant past and extended down to the present generation, and that they were a part of it. It was the Sky Father and Earth Mother who existed through all the stages of creation and united to form the first gods which created other components of the environment

such as trees, birds, rain and humans. Thus humans are interconnected with creation through this spiritual connection. Interestingly, a similar view is expressed by the Haudenosaunee worldview from the Aboriginal people of Canada in that “humans are part of the complex web of life” (McGregor 2004; p.387) and have an important relationship with all aspects of creation. It is therefore, the human responsibility to maintain and enhance their relationship with creation by ensuring its continuation.

These worldviews clearly highlight the fact that humans are an integral part of the environment and thus their existence and continuity depend on it. It is therefore the responsibility of humans to ensure that creation continued by passing on knowledge and information gained throughout the generations from experiences and observations with their environment. In addition, people must also demonstrate positive attitudes towards the environment to ensure its sustainability. What forms an individual’s environmental attitudes and values is therefore discussed next.

2.4.3 Environmental attitudes and values

People respond to a situation in different ways depending on what they believe and value. Perhaps the responses are triggered by their previous experiences and observations of a similar situation resulting in their positive or negative attitudes towards it. The question however is how one defines attitudes and values. Are these shaped by people’s beliefs and customs? If so, what shapes these beliefs and customs? These questions are further explored below.

According to Reser & Bentrupperbäumer (2005), to attempt a definition of terms such as beliefs, attitudes and values may be problematic because confusions with regard the nature and meanings in the discourse already exists within different disciplines and domains. That is to say that the usage of the terms is multidisciplinary and the meanings would differ accordingly. For instance, a mathematician may use the term *value* to mean the readings on a measuring instrument or scale while a jeweller may talk about the quality possessed by a precious stone or mineral. Both examples display the term value being used in context. While it is easier to define beliefs and attitudes, it would be inappropriate

to assume a definition of values at this stage because of its nature which is context oriented. However, in the following sub-sections, I have attempted to define the terms attitudes and values in relation to indigenous environmental knowledge (IEK) systems and how these determine the way people behave towards their environment thus, developing their environmental attitudes and values.

2.4.3.1 Defining attitudes and values

The terms ‘attitudes’ and ‘values’ are linked to ‘beliefs’ and ‘culture’. To understand what constitutes someone’s attitudes and values, it would be logical to understand the culture and beliefs within which they exist. Various suggestions have been made by different researchers on the definition of beliefs although there is no consensus on a definite one. Fishbein and Ajzen (1975, p.12) refer to beliefs as “information one has about an object which maybe a person, a group, an institution, behaviour, a policy or an event”. The Encyclopaedia Britannica (2007) defines it as “a mental attitude of acceptance or assent toward a proposition without the full intellectual knowledge required to guarantee its truth”. Both definitions emphasise the idea of accepting information or knowledge about something as true with whatever available information. This was summed up by Beswick (2005, p.39) as “anything an individual regards as true”. However, Rokeach (1968, p.2) argues that “beliefs could not exist outside a belief system” and that for it to be defined the context within which it exists should also be considered. He added that beliefs vary along central-peripheral dimension so the more central a belief appears, the more chances it has of resisting change as it becomes more connected to others. Beliefs about self or individual identity are more connected than those that are derived (learnt from others) or underived (learnt from encounters with the object of belief). It is within these dimensions that I refer to belief as information or knowledge one has about something that guides their thoughts and perceptions and causes one to behave in a certain manner.

Within indigenous perspectives, beliefs develop over time and may find their way into a culture influencing people’s attitudes and values. In addition, beliefs are often exhibited in a person’s attitude. No matter how good or bad a belief may be,

the underlying fact is that it gets exhibited in a person's attitude. This is underpinned by Fishbein and Ajzen (1975, p.131) comment that "beliefs about an object provide the basis for the formation of attitude toward the object".

Culture, on the other hand, is a term that could be expressed in many ways but Lindstrom & White (1994, p.3) define it as a "system of more or less shared, conscious knowledge and understanding by which people organise how they live together". This is summarised by Frow (1995, p.8) as "a description of a particular way of life which may be expressed in an ordinary behaviour". Both definitions emphasise the importance of people's way of life. This I believe sets the basis for this thesis as it is within the cultural context that people's beliefs are formed and practiced. It is also useful to note that no matter what culture one comes from, there is some form of structure in place that guides how people live together. Even primitive cultures were quite organised according to their clans, tribes and nobility as well as having some set rules that guided their way of life. In addition, many primitive cultures were illiterate yet they had their oral history to guide them as well as having other forms of capturing their way of life such as carvings or totems. For example, the Sepik river people of Papua New Guinea have pictorial storyboards carved out of wood that they use to tell stories about their way of life. In short, culture is about a people's way of life and involves all aspects of a group of people living together and bounded by their own set of rules, traditions, customs and belief systems. It is within these cultures that the belief systems become intertwined and influence people's attitudes and values.

Fishbein and Ajzen (1975) argue that to derive explicit definitions of concepts such as attitudes can be problematic unless the definition provides an adequate basis for the development of measurement procedures. Considerations given to incorporate the theoretical and conceptual aspects of the concept would be beneficial as it is likely to produce a measuring tool. Nevertheless, Fishbein and Ajzen (1975, p.6) describe it as "a learned tendency to respond in a consistently favourable or unfavourable manner with respect to a given object". This definition intends to show that attitude is learned, it prompts action and that such actions are favourable or unfavourable. Within this context, attitudes may develop over time from a

person's past experiences or exposures which may modify their behaviour towards something. Secondly, attitude is considered a variable that can guide a person's behaviour and thirdly, attitudes can be favourable or unfavourable depending on the stimulus object. In adopting the definition by Fishbein and Ajzen, I intend to show that positive attitudes towards one's environment can be developed throughout a person's life time and may directly or indirectly contribute to biodiversity conservation and sustainable use of resources. Thus, an environmental attitude is a learned tendency to respond in a consistently favourable manner with respect to the environment.

The definition of the term values is somewhat indefinite but what one means may depend on the context used. Frondizi (1971, p.8) defines value as "a quality possessed by objects". For example, the value of a gold nugget. The nugget is the object but it possesses a quality that makes it valuable. It is not because we desire it that makes it valuable but it is the quality that the nugget possesses that makes us value it. Other definitions of values refer to it as a "reading or calibration on a measuring instrument" or a "human emotional response or judgment" (Reser & Bentrupperbäumer, 2005, p.127). As a measurement, the numerical value placed on a physical property of an object such as height or weight quantifies it. However, as a human emotional response, one is not able to visualise it unless a physical action is taken by the person to exhibit this. For example, a person rescuing an injured animal and caring for it until it gets well then releasing it back to the wild demonstrates a positive attitude towards nature. Such an action does not have a momentary hesitation of not knowing what to do but that the person knows exactly how they will react and do so instantly. This would be a demonstration of how one values life without any probing from others. What provokes the person to rescue a helpless animal is probably something they have experienced, observed or learnt in their lifetime that caused them to develop affection towards such animals hence their response was instant.

Values are often portrayed as prescriptive beliefs about the existence of something and how individuals, communities or specific cultural groups can conduct themselves personally or socially according to a standard. The question one might

ask is on what or whose standard their conducts are weighed against. I think this is where past knowledge and experiences are vital because these may have guided the communities or groups to set the standards they are to follow in life. This is captured by Rokeach's traditional view that "values are principles and ideas that guide how things should happen in a society" (1973 in Reser & Bentrupperbäumer 2005, p.128) regardless of context and situation.

As the focus of this discussion is on indigenous environmental knowledge (IEK) and indigenous people's perceptions of their environment, it would be appropriate for me to define values as the human emotional responses or judgment that guide a person's attitude towards something. An environmental value is therefore, the human emotional responses and judgements that guide a person's attitude towards the environment. Environmental attitudes and values develop in a person the appreciation and respect for the environment and everything that exist within it. These attitudes and values evolved from people's knowledge and understanding of their environment and how they are expected to behave towards these. How such knowledge and understanding gets passed on to the next generation, who passes this on and who the recipients are is discussed next.

2.5 Indigenous education

The eurocentric views expressed in the above definitions of indigenous knowledge (IK) such as Altieri (1990 in Verlinden & Dayot, 2005) and Bicker et al. (2004) make IK a noun or a thing. Nevertheless, IK is also a process of knowing or learning. This process had to be learnt, respected, shared and received by all who come to contact with. It must also be acquired, interpreted and disseminated to others. The question however is 'how did one come to know IK?' According to Battiste & Henderson (2000 in McGregor, 2004, p.388), "IK is considered as a product or commodity that is rooted in a place and is inseparable from the people who hold and practice it". Within such views, IK is an integral part of the indigenous people who own and use it and pass it onto the next generation. Knowledge in this context could not be separated and had to be disseminated

holistically, thus IK had to be integrated in a form that was possible to be addressed by indigenous education.

A commonality in the definitions of IK that is relevant to this discussion is the emphasis on the importance of human relationship with creation which is intended to be maintained and enhanced to ensure its continuity. With the expectation that this knowledge will be passed on from one generation to the next, the question of how one acquires and learns IK becomes vital. This following subsection aims to discuss indigenous education systems in the light of the above questions and provide an insight into how this was done over many generations.

2.5.1 Indigenous education

The term education in this context is used in its “broadest sense and goes beyond the notion of school” (Sable, 2004, p. 169) to refer to any situation that involves acquisition, interpretation and dissemination of knowledge in any form and approach. I have used the term education here to refer to the process in which all the above occurs through an interaction between the instructor and the learner. For the learner, “acquisition of knowledge is a cyclic process in which one learns through the regeneration and recreation of current and previous experiences including those of one’s ancestors and builds on prior learning and tradition” (McGregor, 2004, p.388). This is similar to formal education process whereby knowledge and skills are learned and unlearned throughout different generations.

The innermost core of indigenous education is described by Cajete (1994) as the education about life and nature of the spirit that moves and that its ultimate goal is to be fully knowledgeable about one’s innate spirituality. This coincides with the view that indigenous education requires a holistic approach to teaching and learning involving “physical, mental, emotional, and spiritual capacities of the learner”(McGregor, 2004, p.388). The development of emotional and spiritual capacity is emphasised in the goal of indigenous education described by Cajete

(1994).

The process involved in the acquisition of indigenous knowledge differs a great deal from the Western context although similarities exist in the process of learning which is quite systematic. For instance, to achieve an outcome in indigenous education, certain processes must occur in a particular order to achieve it. This is very similar to someone executing a scientific experiment to obtain a result. Similarly, indigenous knowledge is acquired from many sources and includes observations and interactions with plants and animals, as well as the other natural objects such as moon and mountains. Knowledge obtained from these sources is placed into three categories by Costellano (2004 in McGregor, 2004, p.387). These include:

- (i) traditional knowledge (passed on from generation to generation);
- (ii) empirical knowledge (gained from observation); and,
- (iii) revealed knowledge (acquired through spirit knowledge and recognised as a gift).

Of these three categories, acquisition of knowledge through traditional and empirical knowledge types is much more convenient because people are able to visually see and experience their impact. Unfortunately, revealed knowledge is often seen as a personal knowledge acquired by having personal encounters with the spirits. Often this form of knowledge is limited to certain people in a community. Nonetheless, it is useful to note that indigenous environmental knowledge has many sources from which it can be acquired and ranges from inherited knowledge, knowledge from personal experiences to those that are revealed by spirits.

Moreover, like western education, indigenous education has specific rules that govern the acquisition of knowledge (McGregor, 2004). It is this fact that often creates problems for many conservation practitioners as they either fail to recognise

the existence of this knowledge or if they recognise its existence, they fail to establish its source. Conflicts may arise in this situation when the sources of indigenous knowledge are not acknowledged.

2.5.2 Teaching and Learning in Indigenous Education

Indigenous education (IE) is informal by nature as much of the teaching and learning process occurs on ad hoc basis whereby acquisition, interpretation and dissemination of knowledge occurs at different locations and settings depending on the type of activity administered. For example, the skills in correct yam planting methods would be conducted in the garden while canoe construction may occur at the beach. Holistic education means that the learners' interrelated dimensions of human potential and personality must be addressed (Antone, 2003). Within such an approach any designed activity must be aimed at achieving these capacities in a learner. For example, designing of patterns for woven cloths, will not only target the emotional capacity of the learner (i.e. how beautiful it looks) but will also be aimed at meeting the physical (i.e. length), mental (i.e. length and spacing of diagonal lines) and spiritual (i.e. type of design on cloth) needs as well.

Some characteristics of indigenous education (IE) described by Simonelli (1997) that enables it to be approached holistically are that it is comprehensive and involves diverse areas of knowledge; it involves nature as the teaching tool and model for the learning process; it teaches through the real situation and favours direct experiences and learning by doing; it takes place between the learners and the community; and, it is environmental education. Such characteristics enable learners in IE to be actively involved and by doing so they become knowledgeable about their environment. The learning from direct experiences and learning by doing approach provide the learners with a wider perspective of their environment.

2.5.3 Situated learning

Indigenous education (IE) is generally informal and occurs on an as-is-where-is basis whereby learners are expected to learn by being an apprentice in various

community oriented activities. The focus of indigenous education in this context is survival, thus every person in a community has the social obligation to learn from the expertise of others in order to contribute to the survival of their immediate family, tribe and community. In this section, I infer that indigenous education is socially oriented and that learning is situated in various social contexts whereby members of the community are the practitioners and that the learners participate in community based activities to enhance their survival skills and knowledge. For example, the weaving of grass roofs for traditional round houses in the Highlands of PNG requires learners to participate in different stages of the weaving process in order to master the skills. This is echoed by Cajete (1994, p.20) that “education in the indigenous context is a communal social activity”. The nature of indigenous education as a communal activity relates the learning process involved as situated learning. The situation in which one learns is often situated within a cultural or social context. Thus the relevance of the theory of situated learning as highlighted by Lave & Wenger (1991) in this study.

The conventional view of learning is that it is “a process by which a learner internalises knowledge whether this is discovered, transmitted from others or experienced in interaction with others” (Lave & Wenger, 1991, p. 47). Situated learning, on the other hand, views learning as a process of participation within a social context whereby the learner’s participation in the communities of practice increases (Lave & Wenger, 1991). What is amiss in the conventional view is that it does not explain what happens to this internalised knowledge. My view however, is that any such knowledge would eventually be exhibited in some form and most often the learner will do this by interacting with others in a situated activity. For example, a beginner learning the principles of weaving may not learn the skill and end there but may be able to demonstrate this by weaving an artefact. The initial act of weaving may occur during the learning process as the learner interacts with the instructor and other participants. However, the situation surrounding the activity reinforces in the learner the ability to interact and co-participate in the learning process by pursuing the skill to another dimension in applying the mentioned skill in a real situation.

Situated learning is described as a socio-cultural approach to learning (Lave & Wenger, 1991, p. 14). It explores the situated character of human understanding and communication and focuses on the relationship between learning as a process and the social situations in which it occurs. It also provides the learner with the opportunity to co-participate with both participants and practitioners and at the same time be involved in all forms of social activities that will provide some basis for learning to occur. As highlighted by Lave & Wenger (1991, p.18), “co-participation enables people to gain access to modes of behaviour, eventually developing skills adequate to certain kinds of performance”. Whether a learner is always involved in co-participation is another issue but their ability to do so provide them with a better chance to advance their skills. For example, a number of learners may be involved in learning the art of dyeing their woven mats to give them a colourful finish. However, a learner who communicates with other learners and compares the different methods of tying mats into sections and chooses one that combines these entire ideas stand a better chance of producing an outstanding product. This example emphasises the learner’s desire to co-participate and improve their skills and knowledge in the process.

Another vital component of situated learning is the cultural setting in which learning occurs. According to Rogoff (1990), learning that considers the cultural setting of the learner is vital for any socio-cultural activity because the relationship of individual development and social interaction cannot be isolated from the cultural context in which the learner interacts. For example, some learning tasks in a community such as knitting of various patterns on string bags may be gender biased in that it is a skill for only women learners to acquire. In such situations it would be deemed inappropriate culturally to administer the skills training to males and to do so may hinder the progress of the male learner because it may diminish his moral and social standing. The importance of the cultural setting and its impact on the learners is evident here. Again, one can also see the importance of cultural settings and its impact on the learners.

2.5.3.1 Situated learning and indigenous education

The informal nature of indigenous education (IE) enables it to be flexible without demands for a fixed curriculum although the societal expectations already emphasise the importance of certain skills and knowledge (i.e. survival) for the purpose of continuity. The topics and venue may also be decided by the instructor who has societal obligations to ensure that appropriate skills and knowledge are passed onto the learner. For example, in the coastal villages in PNG, during the construction of a new canoe, master craftsmen take the opportunity to teach young men the art of canoe making. The process involves everything from choosing the correct type of wood to the designing of the wooden paddles. Anyone interested in learning the art of canoe making would have to gather under the shade of coconut palms to have their lessons. The decision to hold these sessions under the coconut palms is often made by the instructor for two main reasons. Firstly, that the shaded area is the location of the new construction and all required materials would have been provided by the craftsmen. Secondly, it would be appropriate for the instructor to discuss the facts about canoes and their construction as everyone works on the artefact. This form of learning encourages learners to interact and co-participate in the process with other participants and practitioners and as they engage themselves in what they learn, they develop their own understanding.

Quite often the learning processes involved in skills acquisition may be difficult for one person to do on their own, hence other relatives also participate to ease the situation. Another reason for involving relatives is for the purpose of competition. Competition amongst traditional rivals has been in existence in many indigenous communities in PNG whereby a particular clan or tribe would boast about their expertise in certain fields, such as being the best craftsman or gardener and go to the extreme of competing with their rivals in constructing the best canoe or producing the best yams in their gardens. Moreover, within the indigenous PNG societies, individuality is never heard of. People existed as a community and every activity they did from gardening to hunting and fishing was done as a group, usually as members of the same clan or tribe. The point here is that any acquisition, transmission and dissemination of IK are centred within a social context and involve learner participation in a cultural setting. Hence the implication that

indigenous education is socially oriented and that learning is situated in various social contexts.

2.6 Chapter summary

Papua New Guinea is a tropical island country that has much of its original ecosystem still intact although threats of environmental degradation are imminent. Most Papua New Guineans live a subsistence lifestyle and have a great dependence on their environment for the providence of basic necessities such as food and building materials. This dependence of growing populations and the increasing threat of habitat destruction due to development are leading to the loss of anthropogenic and culturally symbolic native species and are highlighting the need for biodiversity conservation.

The co-existence of indigenous people with their environment over many generations has enabled them to develop their own environmental knowledge and practices which are essential for their survival, and which have been influential in determining the people's environmental attitudes and beliefs. This IEK reflects a deep connection between the people and their environment which embodies ideas of conservation and sustainability. In this way IEK could be useful for biodiversity conservation education.

Indigenous education is seen as necessary for the acquisition, interpretation and dissemination of indigenous environmental knowledge. It is holistic in nature and situated in a cultural context, incorporating approaches to teaching and learning that may be of value in biodiversity conservation education.

The next chapter presents the methodology and research design that was used to investigate indigenous environmental knowledge and education in two villages of Papua New Guinea.

METHODOLOGY

3.1 Chapter overview

This chapter documents the methodology used in this research and justifies the theoretical viewpoints of the methodological approaches undertaken. The chapter begins with an overview of the research questions followed by the theoretical framework underpinning the research. The research method is discussed next followed by the data analysis along with validity and reliability issues. The chapter concludes with a summary.

3.2 Research questions

This research was a small scale interpretive study of two indigenous communities' environmental knowledge that may be useful in promoting biodiversity conservation. The study aimed to explore past and present indigenous environmental knowledge and practices of these communities and to identify the various approaches and processes used to acquire, interpret and pass on this knowledge. The specific questions derived from this were:

1. What indigenous environmental knowledge is important for biodiversity conservation in two villages in Papua New Guinea and what fundamental beliefs inform this knowledge? Do the two village cultures share the same views on this knowledge? If not, how and why are they different?
2. How are these indigenous environmental knowledge systems acquired, interpreted and passed on in the two cultures? What tools aid the acquisition, interpretation and dissemination of this knowledge?

The research questions were concerned with the issue of biodiversity conservation

and how indigenous environmental knowledge (IEK) can contribute to biodiversity conservation or vice versa. IEK may also have some commonalities with biodiversity conservation that needs to be explored to provide a better understanding of the relationship between the two and how this can be utilised in providing effective conservation education to promote biodiversity conservation. The research also aimed to show that “education is used in a broader sense and goes beyond the common notion of school” (Sable 2004, p.169). To be educated essentially means to be knowledgeable. Since all cultures and social formations develop a fully knowledgeable person in one time or another, it would be appropriate to talk about the way one became knowledgeable and how one did that through an education process or system. The situation in which one learns is often situated within a cultural or social context. Thus the relevance of the theory of situated learning, as highlighted by Lave and Wenger (1991), in this study.

3.3 Nature of research`

According to Cohen et al. (2000, p.181) two common paradigms employed by educational researchers in the search for truth include the positivist and interpretive paradigms. The positivist paradigm emerges from the idea that human behaviour is fundamentally governed by rules and should be investigated using scientific methods. This is echoed by Johnson (1975, p.4) that positivism is firstly, “a complicated philosophy of science which focuses on the factual character of real world observations” and secondly, “a rigorous methodological program, consisting of a set of formally rational cognitive procedures known as the scientific method”. Within this paradigm, positivists use scientific methods to test hypotheses which are then verified by empirical testing. Positivists develop theory well before the research and use scientific enquiry to investigate this theory.

In contrast, the interpretive paradigm is concerned with individuals and endeavours to build theory that emerges from the data yielded from individuals’ interpretations of the world around them (Cohen et al., 2000). The interpretive researcher uses the data from these interpretations to develop theory which is then used to understand people’s behaviour at different times and places. The interpretive paradigm sets the

precedent for this research as it attempts to explore the human interpretations of their interactions with the environment and how it guides their understanding of the world around them.

A methodological approach that links well with the interpretive paradigm is the case study. According to Cohen et al (2000, p.181), case study “is a specific instance that is frequently designed to illustrate a more general principle”. Yin (1988, p.23) provides a more technical definition as “an empirical enquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used”. Yin’s definition highlights the issue of *real-life context* as the setting of the investigation where the investigator has little control over the events and *multiple sources of evidence* are essential to yield data required to illustrate a general principle or phenomenon investigated. Like other research strategies, case study “is a way of investigating an empirical topic by following a set of pre-specified procedures” (Yin 1988, p.25). It attempts to establish causes and effects and enables the researcher to observe effects of real people in real situations. Yin also emphasises that case study employs various historical techniques of obtaining information but specifically uses direct observation and systematic interviewing which is not included in the historic techniques.

There are several types of case studies, and Yin (1988) describes three of these as exploratory, descriptive and explanatory. Exploratory case studies act as a pilot to other studies and research questions, while descriptive case studies provide narrative accounts and explanatory case studies attempt to test theories. Yin’s classification is also consistent with Merriam (1988 in Cohen et al., 2000, p.183) who identifies three types of case studies as descriptive (also descriptive in Yin), interpretative (exploratory) and evaluative (explanatory). According to Merriam, descriptive case studies provide narrative accounts while interpretative case studies develop conceptual categories inductively in order to examine initial assumptions; and evaluative case studies attempt to provide explanation and judgement. Yin argues that the application of a case study strategy is determined by the type of research questions used. For instance, questions that begin with ‘what’ may need to be explored where as those beginning with ‘how’ and ‘why’ may require

descriptions of narrative accounts and theoretical explanations. There are possibilities that overlapping of strategies may occur however, a precise understanding of what is expected to be investigated by the research questions will provide the researcher with the appropriate strategy to use. Merriam also identifies four domains of case study as ethnography, historical, psychological and sociological. It is within the ethnographic domain that this research was conducted.

Ethnography is defined by Spradley (1979, p.3) as “the work of describing a culture” and aims to understand another way of life (Spradley, 1980). This is further described by Brewer (2000 in Bell, 2005, p.16) as “the study of people in naturally occurring settings or fields by methods of data collection which capture their social meanings and ordinary activities”. Ethnographic research is therefore, a “process involving methods of inquiry, an outcome and a resultant record of the inquiry” that attempts to “create as vivid a reconstruction as possible of the culture or groups being studied” (LeCompte & Preissle, 1993, p.235). Ethnographic approaches are concerned more with description of a context rather than prediction (Cohen et al., 2000) and result in generalised views of situations or groups studied, thus allowing opportunities for comparison of the data yielded. The comparative nature of ethnographic research enables readers to make meaningful comparisons with similar or dissimilar groups. I chose an ethnographic approach to my study because I wanted to understand the indigenous people’s perceptions of their natural world. In order to do this, I had to collect data in the natural settings as the people went about their daily chores.

3.4 Research methods

Various instruments are available to researchers for data collection and analysis. It is the researcher who decides the most appropriate instruments to use for their data collection. While the positivist researcher is concerned with proving or disproving a hypothesis using scientific enquiry methods, the interpretive researcher is concerned with the context within which behaviour occurs (Cohen et al., 2000). This latter focus on context is vital in that it provides the researcher with insight and understanding of people’s behaviour and how this provides meaning for comparison

of the events in the current context with what may occur at another location and time.

Cohen et al. (2000) identify eight strategies of data collection and other various issues within these. The methods chosen for this thesis were interviews and observations which are consistent with Yin (1988), who views these as significant sources of obtaining evidence in case study. Some theoretical perspectives of interviews and observation are now discussed.

3.4.1 Interview

Interviews are interpretive research methods aimed at understanding and interpreting subjective views. An interview involves “an interchange of views between two or more people on a topic of mutual interest” (Kvale, 1996, p.14) through verbal interactions. According to Brenner et al (1985, p.3), an interview allows both parties to explore the meaning of the questions and answers involved. Interviews may be distinctively characterised by the process of seeking and supplying of information. The purpose of the research interview is to gather information in an attempt to find out what people know, value or think because as a research tool, the interview is very flexible. It can deal with a variety of subject matter at different levels of detail or complexity (Brenner, Brown et al. 1985). The use of interviews in research signifies a move away from the traditional view that humans are subjects to be manipulated and towards regarding knowledge as generated between humans through conversations (Cohen et al., 2000). Humans are therefore seen as the central focus for knowledge production and that the social situation in which they exist provides the basis for the research data.

Various types of interviews have been identified in the literature (e.g. LeCompte & Preissle, 1993), however, the ones that are applicable to this research are the ones identified by Cohen et al. (2000) as structured, unstructured, nondirective and focussed interviews. In a *structured interview*, questions are prepared in advance and organised in a well defined format. This provides the researcher with very little room for alteration due to its close-ended status. The *unstructured interview*, on the

other hand is, more flexible as the questions are open-ended allowing for more freedom. *Non-directive interviews* have minimal direction in which the interviewer has minimal control although the respondent has freedom of expressing themselves fully whenever they choose. The fourth type of interview, *focussed interview*, evolved from the non-directive interview in the search for more researcher control. It allows the researcher to exercise control over the interview process in guiding the respondent to respond within a focus or theme. The choice of interview type is guided by the objectives of the study undertaken.

During the interview process, the researcher is expected to be mindful of the social interpersonal encounter between the researcher and the respondents hence the researcher must be sensitive. Brenner et al. (1985) recommends two interview styles that considers the issue of sensitivity - socio-emotional and formal. Socio-emotional style of interviewing enables the interviewer to be supportive and sympathetic to the respondents. Formal interview style is task oriented and aims to provide the same condition for all respondents across all interviews so that the data collection situation is consistent. The nature of the research questions is vital as this determines how stringent the researcher will be in their approach and what style of interview will be appropriately employed. Interviews may occur with individual participants or groups such as focus groups. Focus group interviews consist of a select group who are brought together to discuss a particular theme or topic (Cohen et al., 2000) and whose responses form the data that can be used as a representation of the group.

3.4.2 *Observation*

As discussed earlier, observation is a vital feature of the ethnographic case study approach, as it allows the researcher to “collect live data from live situations” (Cohen et al., 2000, p.305). It provides the researcher with the opportunity to accumulate rich data and develop an in-depth understanding of what goes on in-situ. Observation works well with interviews as together they provide a greater understanding of the context investigated.

Like interviews, observations can be highly structured, semi structured or unstructured depending on what the researcher wants to achieve in the observation. Highly structured observation is one in which the researcher has determined in advance what they will be looking for in some systematic manner. Semi structured observation on the other hand, is one in which the researcher has general issues to look for in a less systematic manner. Unstructured observations are more contextual in nature where the researcher carries out the observation and decides its relevance to the research. The highly structured observations use the observational data to confirm or refute pre-determined hypotheses while the semi structured and unstructured observations use observation data to explain a phenomena and generate hypotheses from it (Cohen et al., 2000).

During observation, “the role of the researcher can vary from being a complete participant to a participant-as-observer to an observer-as-participant and finally to the complete observer” (Cohen et al., 2000, p.305). As a complete participant the researcher fully participates in the research, in an effort to identify with the group from the inside perspective. The participant as observer status allows the researcher to participate to some extent as well as being observant of what goes around them. Spradley (1980) describes the role of participant observer as dual in the sense that they are engaging in the activities as well as observing the situation at hand. The observer as participant status allows the researcher to participate only in a formal context. As a complete observer, the researcher is an outsider and only observes what goes on in the group.

Observations can occur in settings preferable to the researcher and may begin at any time as deemed appropriate. If the researcher works individually then they will be able to commence any time. However, if they work in groups, then some form of training is required for all members of the research team to prepare themselves.

Recording of observations can be done using various tools including transcriptions and observation notes, ongoing notes, descriptions of activities, observation charts, sketches and diagrams, films, photographs, maps, and personal reflective journals (Cohen et al., 2000, p.313).

3.5 Research Design

This thesis was situated within an interpretive paradigm whereby qualitative data was gathered using semi-structured interviews and observations. The interviews were transcribed and later analysed for emerging themes. Observational data was analysed using a similar thematic approach. The research approach used in this study is now described in detail.

3.5.1 Research approach

My reasons for undertaking this research was in accordance with my interest in the indigenous people's perception of their environment and how they are able to utilise their knowledge and practices in the sustainable management of their environment. I was also interested in exploring various approaches through which environmental knowledge and skills were acquired, interpreted and disseminated. The knowledge and skills I wanted to observe were set in the social and cultural context of the indigenous communities so it was essential for me to understand the settings in which they occurred. The research was therefore exploratory in nature and had to be located within the natural settings where the participants would behave naturally. Construction of meaning in this research was done through dialogue with participants rather than through quantification. Participants' knowledge, views and interpretations were an integral part of the research which reflected the participants' perceptions of their environmental knowledge and practices. It was for this reason that the ethnographic case study approach was chosen.

Furthermore, my research took place in two villages, Kinene and Zaukave (these are pseudonyms), one remote and the other semi-urban, both of which were natural settings. Background on these settings is provided in section 4.2. The study was a case study because while I investigated two villages, the findings may provide insight and understanding for other similar or dissimilar situations.

3.5.2 Interviews

As my study intended to represent all members of the community, samples were taken from villager elders, other adults, teachers and students. The interviews I administered were in accordance with Kvale's (1996, p.14) perspectives that there was "an interchange of views between two or more people on a topic of mutual interest" through verbal interactions. Through this interaction, the participants were fully informed of the objectives and procedures of the study. Written and verbal consent were sought from the participants. All verbal consents were recorded on tape. Interviews with the adult participants were one-to-one to enable in-depth discussions.

Focus group interviews were conducted with the children as this was thought to help them feel comfortable being interviewed with their peers and they responded freely while in this group.

3.5.2.1 Adult interviews

Eleven elders and adults were interviewed. Six of these were from Kinene village while five were from Zaukave village. The uneven number in Zaukave was due to the unavailability of one member at the time of the interview. Each of these adults were interviewed at locations where they were comfortable which ranged from the house to the fields.

The interview schedule consisted of 13 open-ended questions (*see Appendix A*). All of the adults and elders were asked the same questions, not necessarily in the same order. The responses given to me were used to probe other questions which allowed the interviews to deviate, although I also directed the participants back to the set questions. Therefore, a semi-structured approach was taken to the interviews. The interviews were conducted in Pidgin English and were later translated into English. Where participants used their local vernacular to name an object or describe something, I involved interpreters to translate these for me. All of the adult interviews lasted for an hour.

3.5.2.2 *Teacher interviews*

There were two teachers, one from each village. Both teachers teach at their village elementary school and were from within the area. The teachers also have some understanding of the local environmental knowledge and practices and freely expressed themselves. The interview schedule consisted of 9 open-ended questions (*see Appendix B*) which were not necessarily asked in the same order. Probing of questions enabled free flow of discussion. Both teachers requested the interviews to be in Pidgin English and conducted within their school area. One interview was done in the classroom after school and one was conducted on the outside lawn during school hours. The interviews took about three quarters of an hour each.

3.5.2.3 *Students interviews*

Two student focus groups, one from each village were interviewed. Each focus group consisted of four students, two males and two females from Kinene and all boys from Zaukave because at the time I administered the interviews, no girls from the local area were present. These students were randomly selected by the teacher to represent the students. The interview schedule consisted of 7 open-ended questions (*see Appendix C*) and were conducted in Pidgin English, which was the language students were comfortable with.

The student focus group in Kinene village were a little unsettled at the start of the interview as they had no exposure to such exercise. It took some time to settle them before I started the actual interviews. The group in Zaukave village were used to visitors and had the experience of having informal discussions with visitors so had no difficulty at all. The interviews lasted for half an hour for each student focus group. In Kinene village, the interviews occurred in the classroom after class while in Zaukave village two, it occurred on the lawn outside the classroom.

3.5.2.4 Interview data analysis

All of the adult, teacher and student focus group interviews were audio taped. Written notes were also made on my copy of the interview schedule and impressions of the participants' attitude and approach during the interviews were also recorded on a record sheet. This enabled me to note their attitudes during the interview. I transcribed the interviews and checked the transcription with my written notes. A summary of their responses were also provided to adult participation for verification and the audio taped interview was also replayed to them. Transcriptions were revised where necessary, and checked against the original audio tape.

The interviews with children were audio taped and later transcribed. No written notes were taken as I felt that this would distract them. I also wanted the children to interact freely and respond without feeling intimidated.

3.5.3 Observations

In addition to interviews with participants, I followed up with four unstructured observations. This was because I did not predetermine these observations but proceeded with it and later decided the relevance of the observed tasks to the research. The observations consisted of construction of a bush material classroom, weaving of string bags by women, preparation and planting of sweet potatoes and a class outdoor activity on identifying forests animals. I also sought clarification from the participants if I was uncertain of anything I observed and made appropriate notes. As an outsider, I was not recognised as belonging to the group so my role in the observation was a 'complete observer'.

3.6 Quality of research

To ensure quality in this study I attempted to use transparency in my methodology, methods of data collection and analysis, research principles and my personal

interests. I sought to achieve quality research through qualitative validity through triangulation of method and data source. Checking mechanisms employed in this thesis were consistent with those outlined by Cohen et al. (2000) and are detailed below.

3.6.1 Sampling

As case study strategy was applied in the data collection in this research, purposive sampling was required. This is consistent with Cohen et al. (2000) where such sampling is applicable in a small scale study. I handpicked the case because I have been exposed to both sites. Kinene is located within the project site of the organisation I work with while Zaukave is located near a conservation park that I have visited many times in my work as a conservation educator. I requested a selected representative of the whole community ranging from the elders, adults, teachers and students. For the elders and adults, I asked the village leader to identify six each, in particular two elders and four other adults. Although, I requested equal participation, the cultural context of the setting restricted participation by women. Kinene village however, permitted two women to participate. With the teachers, I did not have much choice because there was only one teacher in each village. For the students, I requested the teacher to choose four representatives. I did not prescribe any criteria for selection although I requested an equal number of male and female students. Given the practical constraints of time limitations and location of the study sites, it was vital for me to utilise the available sample to access the data.

3.6.2 Validity, Reliability and triangulation

This research was a small scale ethnographic case study that sought qualitative validity in its approach through the triangulation of method and data source. The setting was context-bound and naturally situated, permitting descriptive analysis of data obtained from respondents. In accordance with Lincoln and Guba (1985), the credibility of the study was established through prolonged engagement,

triangulation of data and member checks. I spent three days in each village to conduct my study. As I have been exposed to members of both villages at some point in my previous work, I did not encounter difficulties in being accepted by the communities to conduct this study. Triangulation of data was achieved when both semi structured interviews and unstructured observations were used to source data. In administering member checks, I provided a summary of the interviews for respondents feedback as well as played back the audio taped summary for the respondents to listen to and comment.

Lincoln and Guba (1985) maintained that the naturalist researcher cannot specify external validity although (s)he can provide thick description necessary to enable a person interested in making a transfer of findings to their own setting to conclude if it is possible to do so. The case study approach I employed in this study enabled me to provide a detailed description of the cultural context of my study site as well as the time and place the study was conducted.

The issue of dependability according to Lincoln and Guba (1985) is emphasised by the examination of the process of inquiry to determine its acceptability and the product to attest that it is supported by data and thus confirm its acceptance. I have used the data from this study to provide a descriptive interpretation which is consistent with the findings and recommendations. I have also provided a clear description of how that data was collected.

3.6.3 *Ethical Issues*

Ethical considerations were paramount throughout the research process. Ethical issues relating to informed participant consent, confidentiality of participant responses, transcription of interviews and the reporting of findings, data analysis and securing of information were considerably dealt with. This research was undertaken according to the ethics guidelines and procedures outlined by the University of Waikato with the approval of the Human Research Ethics Committee.

Interviews and observations were undertaken at the time convenient to different

participants. Adults and elders were interviewed at the time appointed by them while the teachers and students were interviewed by arrangement during school days. All adult participants were invited through their village leader while the teachers and students were invited through the teacher in charge or the class teacher.

Participants' consent was obtained by means of letters of invitation. Consent forms were signed by those who were literate. For those who were illiterate, the information was read out to them and their consent recorded on audio tape. Participants were at no stage forced to be engaged in the project or maintain their commitment.

All data collected throughout the research including the field notes, audio tapes, transcripts and images were accessed only by me. To protect the identity of the communities in the study, pseudonyms have been used.

3.7 Chapter Summary

This chapter provides an overview of the research background and the research questions. A discussion of the theoretical framework followed next with a focus on both the positivist and interpretive paradigms. Considerations were given to the ethnographic case study approach used in this thesis. The interpretive ethnographic case study was chosen because the study was concerned with individuals in their natural settings, their interpretations of the world around them and how these interpretations could be used to portray a general view of similar or dissimilar groups. The research methods used were interviews and observations because they were consistent with the interpretive research paradigm. Interviews are aimed at understanding and interpreting subject views while observations allow live data to be collected from live situations. This was followed by a discussion on the issues related to data analysis of the interviews of adults, teachers and students and the observations made. Issues pertaining to quality of research discussed included sampling, validity, reliability and triangulation. Ethical issues were then described.

The next chapter presents the data that was gathered using this research approach.

FINDINGS

4.1 Chapter overview

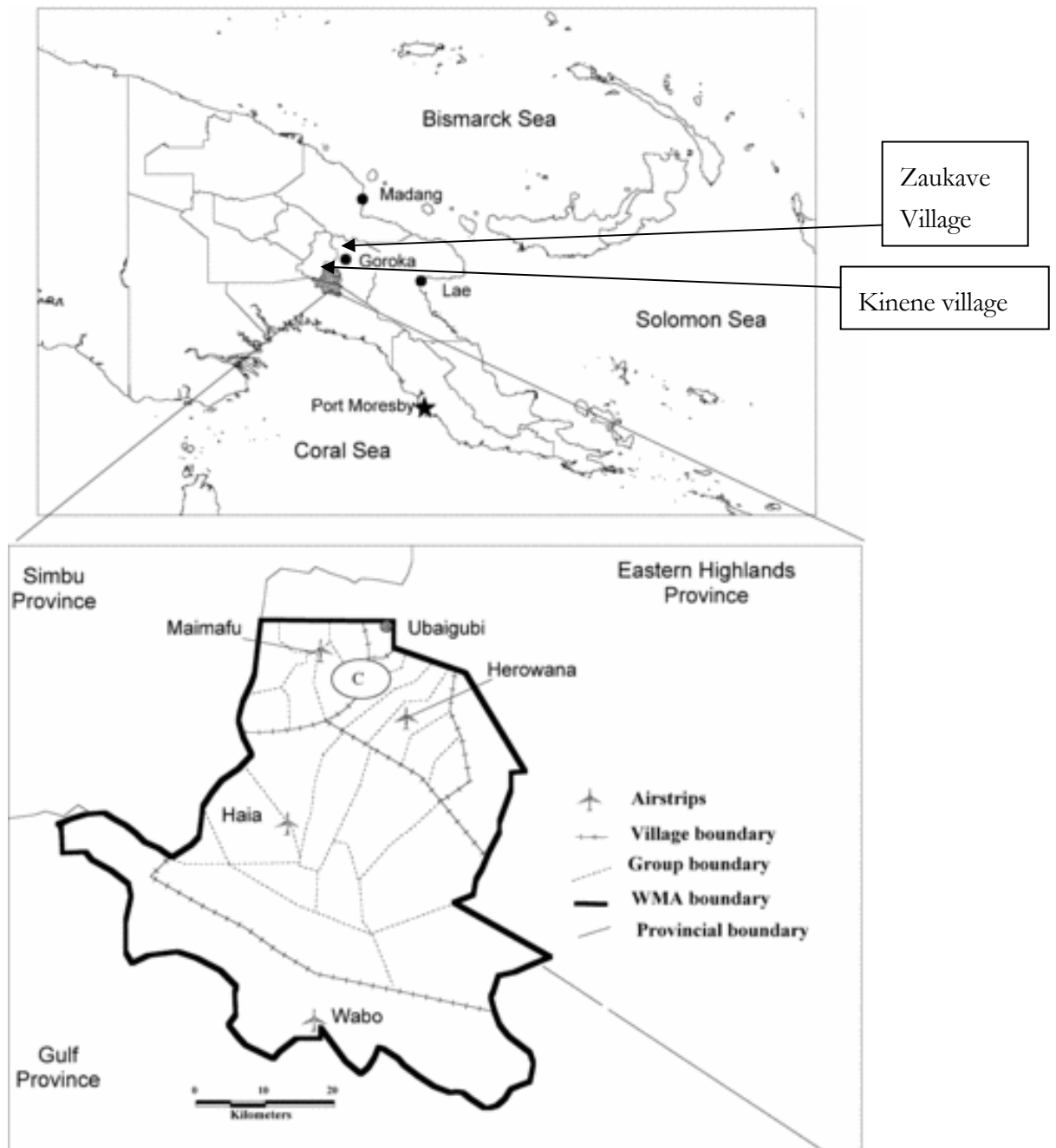
This chapter documents the findings that emerged from the data analysis of the interviews and observations on the role of indigenous knowledge in two villages in Papua New Guinea (PNG). The analysis of the research data has been organised into two sections: Indigenous Environmental Knowledge (IEK) and Indigenous Education (IE). Prior to discussing this analysis, an overview of the study area is presented.

4.2 Description of the study area

This study was conducted in two villages in PNG in July and August 2006. Both villages have been given pseudonyms to protect their identity. The first village, Kinene, is a remote rural village located within the perimeters of the Crater Mountain Wildlife Management Area (CMWMA) in the Eastern Highlands Province (see Figure 4.1). The CMWMA is an area protected within the PNG Fauna Protection and Control Act of 1980 and is managed by the Research and Conservation Foundation (RCF), a national non-profit organisation in collaboration with the local management committees of the villages located within the WMA. The CMWMA occupies 2700km² of land area within three provincial boundaries of Eastern Highlands, Simbu and Gulf provinces of PNG (see Figure 4.1).

Kinene is located 90 km south-east of the Eastern Highlands Provincial capital of Goroka, and is accessible by air on a light aircraft. As a village within the WMA, Kinene has pristine rainforests which consist mostly of mid montane vegetation with a thriving wildlife. As a highland village, it lies at approximately 2000 metres above sea level along the highland fringes with a very rugged terrain. The area experiences very high rainfall. The village is surrounded by mountain ranges and is isolated from the nearby village by about a day's walk. The population

Figure 4.1: Map of PNG showing Crater Mountain Wildlife Management Area



Source: Johnson, Bino & Igag

consists of two major clan groups with about 400 people, including women and children. The people live in small hamlets spread across the hilltop with a long line of houses not arranged in any specific order and overlooking dense forests on each side of the ridge. Their traditional houses are round, mostly built on the ground without windows, and have indoor fire places. The houses are built in this style

because of the cool highland climate. However, there are recent changes in the style of houses with a number of new ones being built on stilts. These changes have resulted from the influence of the Seventh Day Adventist (SDA) church doctrines on cleanliness and hygiene as well as exposure of the people to other types of houses such as coastal houses which are generally built on stilts for adequate ventilation. Houses built in this way create space underneath for storing captured animals, firewood and other items that are too big to take into the house. Breeding of captured animals is not a practice from the past because people were able to hunt regularly. However, this cannot be said for the present time as hunting has now become an irregular practice resulting in the breeding of some animals both for consumption, bride price payments and other cultural ceremonies. Generally the houses in Kinene are made of bush materials with the exception of the church and health centre which are made of permanent materials. The main materials used for building round houses are timber posts, bamboo walls, and cogon grass (*Imperata cylindrica*) thatched together for the roof. The people of Kinene are mostly farmers living off subsistence agriculture which provides for their daily needs.

The second village is Zaukave, which is a semi urban village located 9 kilometres north-west of the outskirts of Goroka, the provincial capital of Eastern Highlands. Zaukave is not isolated because the neighbouring villages are within less than an hour's walk apart. The village is located at the foothills of Mt Gahavisuka Provincial Park, a conservation park which is also protected under the Fauna Protection and Control Act of 1980, and is accessible by road; about 20 minutes drive from the town centre. The vegetation at the summit of the park is mostly pristine mid montane forest with a lot of secondary forest bounding the bottom of the park. The valley surrounding the village is mostly grassland, populated by coffee plantations and very dense garden lands.

The village consists of three major clan groups making up a population of 600 or more villagers. Apart from the villagers, there are settlers who have bought blocks of land and have settled in the area. The types of houses they live in vary from those that are completely made of traditional bush materials to semi-permanent and permanent houses. The bush material houses are round, built on the ground without

windows, and have fire places built in them. The fireplace is built indoors because of the cold highland climate. The nights are often cooler so by making fire indoors, it circulates the heat that warms the inside of the house. Secondly, as fires are made indoors, the smoke that passes through the cogon grass acting as a drier for the thatching. The smoke acts as a preserver and prevents the thatched grass from disintegrating. If no fire is made for long periods of time, then the thatched grass roof will rot and break easily.

Like the Kinene round houses, the Zaukave round houses are also made of timber posts, untreated bamboo walls, and thatched cogon grass (*Imperata cylindrica*) for the roof. The semi permanent houses are mostly rectangular in shape and built on the ground with cement floors. They are made of timber posts, treated or untreated bamboo walls and corrugated iron roofs. These houses often have windows and an outdoor fireplace. The outdoor fireplace is made to prevent the smoke from blackening the corrugated iron roofs. The permanent houses are mostly made of corrugated iron roofs, steel posts, treated floor boards, brick walls and cement. The population is not entirely dependent on subsistence agriculture as some do have paid jobs in town while others are self employed in trade stores or coffee export businesses.

In the following discussions, the data coding will be represented by the use of the abbreviations K to refer to Kinene village, Z to refer to Zaukave village, and the numbers to refer to the interview and page number of each transcript.

4.3 Indigenous Environmental Knowledge

This section discusses the practices of the people linked with the knowledge and understanding of their environment; the relevant knowledge related to the use of forests resources; the spiritual knowledge and beliefs that forms the basis of their relationship with the environment; the practices on sustainable use of resources and the current changes in the use of resources in response to changing demands.

4.3.1 Environmental practices

The notion of environmental practices in this study refers to the various indigenous practices that involve land cultivation, skills and knowledge relevant to hunting and the construction of houses and artefacts. It also refers to practices that demonstrate the application of this knowledge and associated skills. For example, constructing of drainage to remove excess water to avoid crops drowning is an application of the knowledge about the topography of the area. An additional factor that emerged from the analysis of the results is the Kinene and Zaukave people's indigenous family knowledge and history.

4.3.1.1 Indigenous family knowledge

The findings in this study showed that both the Kinene and Zaukave people have a sound understanding of their family history and origin. For instance, of a total of eleven adults and elders I interviewed, ten of them described their family history while only one male adult from Zaukave admitted to having no knowledge at all. The reason for him not knowing his family history is because he had not made an effort to learn it. As indicated by his comment, "I'm not really sure as I have not asked my father about it" (Z3, 1). The significance of this form of knowledge is that it determines their land and resource inheritance and enables them to know where to plant their gardens, hunt for bush meat or wild eggs and construct their houses. Clan boundaries and territories are very clearly marked by physical landscapes such as rivers and mountains or natural vegetation such as bamboos and cordylines which are clearly identifiable. With this knowledge, they (can) claim ownership of various parts of the village and forest lands and identify with those of the same clan. Waiko and Jiregari (1982) discussed the perception of the Binandere people of PNG as being similar, whereby they believe that their family knowledge is vital in that this and their empirical observations of the environment would provide guidance for their survival. Moreover, Lacey (1981, p.45) described indigenous family knowledge as "special and secret and would normally be communicated within the depths of the men's house" when describing the traditions of origin and migration of the Mulapini people of Enga Province in Papua New Guinea. The special nature of this form of knowledge causes people to communicate only with those of their

kin with whom they share land and other resources. This is also true for the Kinene and Zaukave people for this knowledge enables them to recognise their clansmen with whom they can cooperate and assist in terms of constructing new gardens or houses. It also allows people to live and interact with each other because their survival is dependent on each other. This was echoed by one Kinene elder that “the people operated as one. They worked together and helped each other in the different areas of their lives by cooperating” (K1, 1).

Cooperation and unity was vital for the survival of the Kinene and Zaukave people. Moreover, they knew that their survival also depended on their ability to work hard as it paid off when they had surplus food to support themselves and their kinsfolk. As indicated by a Kinene elder, “apart from the knowledge they had about this area, they were also very hard working people. To work hard means one would have more than enough supply of food for one’s family” (K2, 1). Being hardworking and cooperative did not only contribute to their survival but enabled them to know where and how they could obtain construction materials and bush tucker. A Zaukave elder echoed these sentiments in stating that:

My people lived that long in this area because they knew where to obtain bush materials for building their houses, where and what type of food plants to plant, where to collect wild fruits and berries and where to hunt. They knew how to survive in this place in a practical way (Z1, 1)

Being in possession of indigenous family knowledge is essential for inheritance of land, resources and clan identification. It enables a person to claim ownership of land and resources and share these with other members of the same clan. Therefore it is essential for knowledge to be imparted to the next generation. The approaches clan elders take to disseminate this information to younger clan members is discussed further in section 4.4. However, in the following sub-section, the subsistence practices of gardening, hunting and construction are discussed and the knowledge possessed in regard to these practices is also highlighted.

4.3.1.2 *Gardening*

The cultivation systems in Papua New Guinea have evolved greatly but are still closely adjusted to environmental conditions. They vary in different parts of the country and are often characterised by particular conservation techniques based on different ecological zones, altitude, climate and soil (Wood & Humphreys, 1982). The ecological zones are based on relief and vegetation, and consist of swampy lowlands, forested lowlands, savannah, mid attitude and highland.. Both Kinene and Zaukave are classified in the mid attitude and highland ecological zones respectively. Thus most of the cultivation practices in this study are common to these two zones.

Cultivation of food crops, particularly in gardening, is the sole means of food production for most rural families and has been practiced over many generations. In both Kinene and Zaukave, gardening is practiced for this purpose although in the latter, additional food is also produced for sale at the local markets in town for cash. The gardening techniques used in both villages differ in that slash and burn is practiced in Kinene while in Zaukave crop rotation is used instead. The reasons for the use of these techniques are that in Kinene, there is an abundant supply of forest and bush, which to the people means the soil is nutrient rich and that people could continue to slash and burn. On the other hand, in Zaukave, there are limited forest and bush areas available so they are forced to practice crop rotation instead. This was further emphasised by a Zaukave elder:

Currently, we do not make new gardens frequently like in the past. We simply rotate the crops in the old garden. For example, after harvesting sweet potatoes, we plant peanuts and beans. After these are harvested, we replant sweet potatoes and so on. (Z2, 2)

In crop rotation, certain leguminous plants such as varieties of beans and peanuts are planted in rotation with sweet potatoes. This process continues for a period of time until the soil is replenished with nutrients such as nitrogen, potassium and phosphorus.

What's more, the general gardening practices in both villages are similar in many ways albeit having significant differences. For instance, in both villages, to make a new garden the bush is cleared of all trees, shrubs, lianes and unwanted grass which are left to dry. The big trees are cut and split into smaller portions for timber posts which are used for erecting fences. After the completion of the fence, the dried shrubs and grass are burnt. Often some individuals decide to burn the dry vegetation before erecting the fence. The completion of the fence and the burning of the dry vegetation prompt the beginning of the planting process. It is at this stage that differences are noted in some of the practices between the two villages. For instance, in Kinene, the women begin planting the crops soon after fencing is completed while in Zaukave, the soil is prepared first. Soil preparation involves ploughing to unclog it from plant roots and debris so that it is aerated for maximum plant growth. This is indicated by this quote from a Zaukave adult, "the soil is ploughed to loosen it so that crops will grow well in it" (Z2, 2). Over a long period of gardening through trial and error of various practices, the local people discovered the importance of ploughing the soil before planting. This knowledge was discovered over many generations of gardening.

Secondly, the Zaukave people are knowledgeable about their soil type as this has the tendency to hold a lot of water. By ploughing it, plant roots and debris are removed and the soil becomes loose and free helping crops to grow well. In addition, a proper drainage system is constructed to draw off excess water so that the crops will not be flooded. The mounds are then constructed followed by the planting of the crops, particularly sweet potatoes. It is common practice in Zaukave to plant sweet potatoes in mounds "so that they can grow big" (Z1, 2). Again, planting of sweet potatoes in mounds is one of those practices that people had to trial over many generations to settle for the best technique.

For Kinene, mounds are only made to plant yams. That is, firstly a hole is dug in the ground, and then the sprouting yam is placed in it with the rest of the soil gathered around it to make a mound. The Kinene people believe that the construction of the mounds increases the size of the yams. As an adult explained, "to plant yams, we make mounds and plant them so that the yams will grow well and also big" (K4, 1). As a tuberous plant, the yam has the tendency to grow horizontally as well as

vertically under the ground. If the mounds are made then the yams grow and fill them up resulting in bigger yams. When planting sweet potatoes and taro, the crops are left to grow for a couple of weeks after which the women accumulate soil around the base of the crops to create mounds. The purpose of the mounds is to maintain the temperature at a certain level which is conducive to the growth of the crops. As discussed by a Kinene adult, “after the crops grow, we would gather the soil around the sweet potatoes and taro so that the warmth from the ground will make them grow very big” (K6, 1). With the location of Kinene in the mountains, the climate is cold so the crops would not grow well if left unattended. It is therefore the responsibility of the gardener to ensure that the crops are tendered whenever necessary. Interestingly, as the last of the crops is planted in the garden, the Kinene women would often chant some magic spell. This was explained by the Kinene student focus group that “some people, especially women, chant some magic spell as they plant their crops so that they will grow quickly” (Kstd, 3). This action is related to a spiritual belief which is elaborated on further in section 4.3.3.

Although the reasons surrounding the differences in the gardening practices of Kinene and Zaukave are unknown to an outsider, the people obviously know the reasons for these. For example, the Kinene people insinuated that ploughing will cause the rich topsoil to be washed away because of the location of the garden on the slopes. This situation can be aggravated by having drainage systems. Moreover, excess water does not accumulate on the slopes as it naturally run off easily. A Kinene adult elaborated that “we make gardens on the slopes that already have a natural drainage system. There’s no need to plough it and make drains like people in the valleys do” (K2, 3). The knowledge of the topography, soil type and climatic condition of the area displayed in this context demonstrates the people’s understanding of their IEK which had been accumulated over many generations of practice and passed on through oral history, visual observations and imitation.

Other findings that emerged from the results of this study indicated that the control of new growth in a cleared area is done by burning dried vegetation on the same location. As stated by the student focus group in Kinene, “the grass will grow again so it must be burnt to control it” (Kstd, 3). In addition, the findings also revealed

that both Kinene and Zaukave people plant vegetables like pumpkin and edible green leaved vegetables on the ashes of a burnt area. This is because the ash acts as a natural fertiliser and increases the growth of the vegetables. As stated by a Zaukave elder “the dry bush is burnt to get the ash which is then spread over the soil. The ash will fertilise the soil so vegetables like pumpkin and edible green leaved vegetables can grow well on it” (Z2, 2). This useful knowledge and practice discussed above has been obtained from past experiences and observations of the people over a prolonged period. Both villages are aware of the importance of using fire and ash and have practised the application of this knowledge over many generations.

The preparation or reuse of old gardens is treated in a slightly less aggressive manner than the new gardens described above. After using garden land for a couple of years, the villagers would often leave the area fallow for a year or more before returning to continue gardening. The fallow period is often determined by the amount of land available to the gardener. On average, the fallow period in Kinene can range from five to ten years while in Zaukave it may be a year to two years. The reason for fallowing the land as discussed by Paglau (1982) is to give it rest to enable it to produce better. Although the Zaukave practice crop rotation, they are still obliged to fallow the garden area for a while because they do understand the need for the land to rest from being over used. It is the responsibility of the gardener to ensure that their land is rested before being used again.

The gardening practices discussed above are not exclusive to Kinene and Zaukave villages as these are also common in other parts of Papua New Guinea (Paglau, 1982; Wood & Humphreys, 1982). The issues for consideration are the knowledge that exists in the practice of garden preparation, differences in the planting techniques and the gardening methods used by the Kinene and Zaukave and their relevance to biodiversity conservation. The implications of this are discussed further in chapter 5. However in the following section, the analysis of hunting practices is discussed, as this is another vital practice relevant to the environment is discussed.

4.3.1.3 *Hunting*

The majority of the rural people of Papua New Guinea depend partly or wholly on the use of the country's many species of animals and plants. Hunting is a common pastime which is often practiced for obtaining animals for sport or food. From the findings in this study, the most common reason given for hunting is to obtain bush meat. All of the thirteen adults (including elders and teachers) and the student focus groups in both villages stated the obtaining of bush meat as the main reason for hunting. For example, a Kinene adult explained that "hunting was mostly to meet the needs for bush meat" (K6, 1). The varieties of animals hunted include wild pigs, tree kangaroos, possums, bandicoots, cassowaries and various other birds. Wild fowl eggs are also gathered particularly by women as they are conveniently located in mounds in the ground which are easy to dig.

The second reason for hunting is to obtain materials for cultural activities such as bride price payment, costumes for traditional dancing and cultural ceremonies. Parts of animals such as feathers, furs, bones and hides or the whole live animals are taken to be used for these activities. As pointed out by a Kinene elder, "we mostly hunt cassowaries which are also needed for cultural activities such as bride price payments" (K1, 3). Another Kinene adult added that:

They are not only used for food but also for other reasons. For instance, we can use the whole bird for bride price, the plumes for traditional costumes, and the bones as knives for cutting certain foods such as the red pandanus (K2, 3)

For bride price payment, the animals are captured live and taken as captives for breeding until the planned ceremony occurs. The animals are then arranged with the other items for bride price payment displayed for the approval of the bride's family. To prepare traditional costumes like headdresses, feathers and plumes of cassowaries, birds of paradise parrots and other birds are used. Animal bones such as cassowary limbs are used as cutting tools while pig's tusk and other animal teeth are used as necklaces. The furs and hides of small marsupials like tree kangaroo and possum are used as body covering particularly around the chest area or woven into

grass skirts. This is commonly worn among women as costumes for traditional dances.

The various types of tools used by Kinene and Zaukave villages to hunt wildlife include traditional bows and arrows, dogs, traps and guns. By far the most common tools used in both villages are the bows and arrows. This was stated by twelve of the thirteen adults interviewed. For instance, a Kinene adult stated that “the tools used for hunting are mostly bow and arrow” (K6, 1). The student focus groups in both villages also identified these as the main hunting tool. Bows and arrows are popular hunting tools because not only are they used for this purpose; they are also used for tribal fighting. For this reason they are convenient to carry around. The use of hunting dogs is popular in Kinene but not in Zaukave. Four of the seven adults (including elders and teacher) in Kinene indicated that hunters used dogs for hunting. Dogs are depended upon because they can pick up the scent of the other animals and pursue them, making it easier for the hunter to shoot them with his bow and arrow. In addition, the use of guns and traps were mentioned by four Kinene adults whereas none of the Zaukave adults mentioned these. The use of guns increases the chances of killing the animal instantly so it is used for accuracy in shooting without missing the target. On the other hand, traps are used if whole live animals are intended to be caught. In addition, traps for smaller mammals such as bandicoots are often made with fruit used as bait. Traps can differ in size and structure depending on the type of animal it is intended for.

In Kinene and Zaukave, hunting was not just another ordinary activity which anybody could do. It was a task entrusted only to designated hunters who would usually be good marksmen or had a good hunting dog. During hunting, men would go with one or two designated hunters who would shoot or catch the animals for the hunting team. This was emphasised by two elders from Kinene, whereby one stated that “only the marksman or ace shooter is the one who can confidently hunt animals, others don’t” (K1,3) while the other stated that:

....there were only one or two designated hunters. Only these people
(often an ace shooter) were responsible for killing the animal. Others who

go with them would often stay around the camp area and when the hunter kills an animal they would go and bring it back to camp (K3,3).

Designated hunters are men with special hunting skills that enable them to always catch their prey. If they shoot, they are likely to kill the target. In Zaukave, they are believed to possess magical spears. A designated hunter is also one who has a greater understanding of the forest, particularly animal movements, feeding time and location. His knowledge of his environment enables him to locate animals without difficulty. Unfortunately hunting is not frequently practiced than used to be. Both villages have indicated that there has been a decline in the practices. The reasons for this decline are elaborated on further in section 4.3.5.

Another vital issue that emerged from this finding is that hunting had to be done only in one's designated land. As pointed out by a Kinene adult, "they are expected to hunt on their own land and obtain everything they need from their own land" (K5, 1). Any hunter who goes out to hunt must do so on his own land. As mentioned earlier, a designated hunter is one who is very familiar with the forest on his own land so it is appropriate for him to hunt there as well. When a designated hunter takes a hunting team into his own forest, there are no questions raised because he is the rightful owner of the land. If he did not, there will be confrontations with the rightful landowners. For example, before an outdoor activity by the elementary school in Kinene I observed that the teacher and the children had to seek permission from the owners of the forest that was going to be visited. This action demonstrated the importance of landownership and the respect the people have for each other's land. In addition, with the clans controlling hunting regulations in their designated land boundaries, any overuse of resources remains their responsibility. If a clan runs out of resources in their forest land, then this is an embarrassing situation. They would be known as people who are selfish and do not think of the future by overusing their resources. Therefore, clan boundaries play an important role in biodiversity conservation and sustainable resource use as it creates a clear distinction on land boundaries which forces people to be mindful of the amount of resources they obtain from their lands. Further issues on hunting and sustainable practices will be elaborated in section 4.3.4.

Although hunting is predominantly practiced by men, there are exceptions where a female can hunt. For instance, one female adult in Kinene explained the reasons why she had to violate the norm in hunting practice by doing it herself. She explained that, “I’ve taught myself how to hunt because I’m a widow and I had to find protein for my family because my children were young at that time” (K4, 2). The woman’s predicament of losing her husband meant that she had to do the work that he would normally do, like hunting. Unlike the male hunting team, this female would either go alone or with her children. Moreover, the size of the animals she catches would be smaller so that she would be able to handle it unless she was able to catch something big like a cassowary. Nonetheless, hunting was normally associated with men as it required travelling long distances into the forests as well as staying in the bush for long hours regardless of the weather conditions. The harsh realities of hunting are often difficult for women to handle and naturally, this has decreased their interest in the activity. Moreover, hunting is an important practice as it is the means by which animal protein is obtained to supplement the villagers’ staple diets of sweet potato, taro and yams.

4.3.1.4 Constructions

The use of the term construction in this study refers to building of houses, fences and artefacts such as bows and arrows. Construction of houses and artefacts are considered men’s jobs and so involve mostly men and young boys. In the rural societies of PNG, a man is considered lazy if he is not able to build his own house. Often before he marries, a man is expected to be able to construct a house. He would usually do this with the help of his own family and clan members, particularly in the collection and preparations of materials. The male relatives would assist him in the actual construction of the house. Both Kinene and Zaukave are highland villages so the general procedures involved in house constructions are very similar. As described by a Zaukave adult:

To build houses, we clear the area to construct the house first. Then we collect timber posts from the bush, cogon grass for the roof,

bamboos, rattan, and other required materials. We gather these at one location until we have all the materials we require before the construction work begins (Z5, 2).

The materials used for constructing different types of houses (bush material, semi permanent or permanent houses) have already been mentioned in section 4.1. However, the traditional round houses are popular and the skills involved in the construction of these are expected to be known by every man in the village. The practice of building traditional round houses on the ground without windows and with a fireplace inside is to ensure that the warmth is kept indoors because of the cool highland climate.

An additional reason for building houses using bush materials is that the materials are readily available from the forests. The choice of what materials to use is carefully considered because the materials will determine how long a house will last. For example, in Kinene village very strong posts are required to construct a house that will last for nine or ten years. A Kinene elder emphasised this by naming the type of trees used for timber posts. He stated that “the types of trees we use include uamie (oak of the species *Castanopsis acuminatisima*) for fencing as well as house construction and mogoya (corkwood of the species *Euodia elleryana*) is used for the frames of the house” (K3, 1). The Kinene student focus group also identified these by pointing them out. A male student in the group stated that “to cut timber posts we choose very strong trees. For example, this one is called fugame (another name for *Castanopsis acuminatisima*)” (Kstd, 1). How long a house lasts is determined by the people’s knowledge of the tree types and the specific type used for different components of the house. Special care is also taken in ensuring that the bamboo walls are woven carefully so that warmth is kept within the house.

An artefact that is commonly constructed by the Kinene and Zaukave men is the bow and arrow. The findings in this study revealed two uses of bows and arrows for hunting and as weapons for tribal fights. This is supported by a statement from a Zaukave elder that “not only do we need bows and arrows for hunting; we also use them for fighting” (Z4, 2). To be able to kill an animal during hunting or an enemy during tribal fights, both the bow and arrow must be solidly made from strong

durable materials. In both villages, arrows are made from mature cane grasses (*Miscanthus floridulus*) which are then heated throughout the construction process to harden the head and the stem of the arrow. The bow is made from black palms. The trial ones constructed by boys are made of soft bamboos and young cane grass. The boys use these to practice hunting small animals. This was elaborated on by the boys in the Kinene student focus group who stated that, “we can also make our bows and arrows from soft bamboo to hunt lizards” (Kstd, 2). The other student focus group from Zaukave also shared the same sentiments that, “in order to learn how to make bows and arrows, we started off by making trial ones from soft bamboos. These we use to hunt lizard and small birds” (Zstd, 3). The bows and arrows made by boys in this way are not strong and will break easily because the materials used are not intended to last long. Like the men, the Kinene and Zaukave women also construct their own artefacts which are the string bags, locally known as bilums. These serve various purposes such as for carrying personal stuff, babies, garden produce and other cargoes. The process involved in string bag making is further discussed in section 4.3.2.1 under plant resources.

The third type of construction is fence making. Fencing is mostly related to gardening and is erected around the gardens to keep out wild animals. In Zaukave, fencing is done to keep out domesticated pigs as well as human beings. The construction involves the selection of appropriate tree types such as oak which are split into sizable posts of about a meter in height. These are erected close together around the gardens. Bamboo strips or mature cane grass are horizontally tied onto these posts with rattan cane or nailed together with nails. The style and type of fencing in Zaukave has changed as pig wire bought from hardware shops is now used for fencing gardens. The reason for this is because metal wires do not rot so there is no need to replace them frequently like the bamboos and cane grasses.

All in all, construction of houses, artefacts and fences is an important practice in Kinene and Zaukave villages and therefore needs to be passed on to the next generation. The methods and approaches involved in the dissemination of construction knowledge and skills are discussed further in section 4.4.

4.3.2 Spiritual knowledge and beliefs

The belief systems of indigenous people are often influenced by the spiritual knowledge they possess, personal encounters with nature or experiences of others both past and present shared through myths, legends and folklores. Often the belief systems are intact and influence people's perceptions and attitudes towards nature and the environment as a whole. The Kinene and Zaukave people, like other indigenous people of the world (McGregor, 2004; Narokobi, 1980; Waiko & Jiregari, 1982) are no exception. They have existing belief systems that influence their perceptions of the world around them and enable them to develop connections with their environment. This section discusses their spiritual knowledge and beliefs and how these have influenced their attitudes towards their environment. The findings of this study are grouped into spiritual knowledge, beliefs about plants and animals and those related to the physical environment.

4.3.2.1 Spiritual knowledge

The Kinene and Zaukave people's strong connection to their environment is emphasised by the spiritual knowledge they possess which explains their views about their environment and how they perceive it. By acknowledging the presence of the spirits, the Kinene and Zaukave people acknowledge the interconnectedness between their physical and spiritual worlds. They acknowledge that these two worlds co-exist and that one cannot be considered without the other. Every unexplained phenomena or incidence is linked to the spiritual world. For example, if a person suddenly falls sick after being completely healthy for a long time, then the people will immediately relate this to a spiritual attack because the person may have done something wrong or may have been cursed by a spirit or magic. Thus the shaman is called to do rituals to establish the cause of the illness and chase the spirits away. Similarly, creation stories and other similar stories about origin, greater powers or supernatural beings illustrate the existence of a spirit world. Various forms of spiritual knowledge are a demonstration of this world.

With regard to living organisms within their environment, the Kinene and Zaukave people have an explanation for their existence. There are myths and legends explaining how a plant or animal came to be in their forest. For example, the following myth told by a Kinene elder portrays this:

A group of men returned from a war with their tribal enemies. As they crossed a river and followed the mountain ridge, they came across a clearing. When they approached this clearing, the wind stopped and everything was suddenly calm. Then they heard the cracking of dry twigs in the nearby bushes. As they stood still and watched, they saw a young woman walk across. She carried a string bag on her head and held a digging stick in her hand. As she came closer to the group of men she lifted her head and looked at them. Then she let go of her digging stick which she stood against the nearby tree and used it to climb onto the tree. As she reached the branch, she turned into a tree kangaroo called kawale in the local dialect. It was not until they saw the woman turning into the tree kangaroo that they realised that it was a spirit and not a real woman (K1,1).

In the above example, the origin of the kawale or tree kangaroo is related to the human spirit. Thus any taboo in whatever form, placed upon this animal was done as a show of respect to the human being who once lived.

Other existence of spiritual knowledge is demonstrated by the activities carried out by people such as use of magic or being in possession of magic items related to any practice such as gardening or hunting. For example, the Zaukave people believed that the best hunter in the village possessed magic spears given to him by spirit beings. This is illustrated by this explanation from a Zaukave elder, “we also have a belief that the best hunter in the village is the one who has magic powers obtained from the magic spear given to him by Nokondi, a spirit being” (Z2, 1). Another example from Kinene demonstrates the use of magic powers in gardening. This is illustrated in this example given by a Kinene elder that, “if yams are planted, then the women who know the magic words are often called to put a spell on the yams to make them grow bigger and more quickly” (K1, 2). The chanting of magic is only done by women who know the chants; usually they would have inherited it from their mother or an elderly clan member.

Apart from possessing magic items and knowing magic spells; spiritual knowledge is also demonstrated through the gifts of having visitations by spirits through dreams and visions. Through this medium the spirits reveal secrets and knowledge about things to the dreamer. Often the dream or vision may reveal to the dreamer the location of an animal so that the next day if the dreamer goes there, they would be able to find the animal as revealed. For example, this was described by the Kinene teacher that, “sometimes, it is believed that when a person is given dreams or visions by spirits about an animal in the previous night, and they go hunting the following day, they will catch that animal” (Kt, 1). The visitation by spirits to give magic tools or dreams is an indication that the individual is favoured by spirits and so has special powers.

The use of magic and visitations by spirits is linked to only the people who possessed special powers. Someone who has spiritual knowledge of any form is thought to be one with these special powers. Such knowledge is described by McGregor (2004, p.387) as “revealed knowledge” and is said to be possessed by a few people only.

4.3.2.2 *Beliefs about plants and animals*

Beliefs are not only related to spiritual knowledge as discussed above but are also linked to past experiences which may have been wonderful or terrifying depending on personal encounters. Such knowledge and experiences lead to the development of taboos or restrictions placed upon plants, animals or places.

Beliefs related to the use of plants and animals are mostly related to their use as food sources. That is, whether the plant or animal should be hunted, collected and eaten or not. For example, a Zaukave elder described the importance of the restrictions imposed by their ancestors:

Generally, edible plants that our ancestors have used over many generations are what we would usually consume. We do not eat anything that is bitter or

has not been consumed by our ancestors before us. The same applies to animals. If our ancestors put a taboo over something then we would usually not violate that because if we did we may get sick and die (Z1, 1).

Some plants and animals that are forbidden for eating are linked to spiritual reasons. For example, a Kinene adult explained that “when a hunter attempts to hunt a tree kangaroo but if it falls on its back and gets up to run away, then it should not be killed and eaten” (K2, 2). This belief emphasises the view that the animal may be a spirit and should not be tampered with because doing so may bring the wrath of the spirits on them. If it was a plant, then the belief may be that it is the dwelling place of the dead spirits so no one should cut it or go near it. This is illustrated in this example by a Zaukave adult, “trees are considered the place where spirits of dead people lived, thus are sacred” (Z5, 1). This belief develops in the people the awareness of the importance of trees as dwelling places of spirits resulting in respect for trees as sacred entities.

Other beliefs are rooted in the principles of respect and morality. For instance, trees should not be cut if they are growing on someone’s land. This is illustrated by this a statement from a Kinene adult, “if a tree grows on a person’s land boundary, and I go and cut the bark or some parts off it, then it is said that I have killed the person’s spirit” (K5,2). A Zaukave elder also stated that “we are told not to cut down trees unnecessarily because if we do the trees will bleed just like humans” (Z4, 1). The relationships of trees and human qualities emphasise the unspoken understanding that trees have the right to live and may need to be cut only when necessary. This is an indirect conservation practice that has a useful implication for conservation in that it promotes conservation of a particular tree species.

Whatever the reason, beliefs about plants and animals have become important for the Kinene and Zaukave people because it links them to their environment.

4.3.2.3 Beliefs about physical environment

Plants and animals are not the only things in the environment that Kinene and Zaukave people have beliefs about. The places where these plants and animals live

such as the forest, caves, rivers and mountains are also sacred to the people. As discussed by a Kinene elder:

There is a waterfall near here that is a sacred place. If people eat meat they do not go there because the spirits of dead people are believed to live there and if they eat meat and go there, they can die. Also when people go there, if they hear people whistling or talking they don't respond because if they do they can also die (K3, 2).

A Zaukave elder also added that "there is a cave nearby that is a sacred place so we don't go there for fear of being attacked by spirits" (Z4, 1). Another Kinene adult added that:

In such places as the waterfall that is said to be haunted with spirits, there are lots of animals still living there. If people get animals from this place, they will go insane and roam the forests until people find them and bring them back to camp (K6, 3).

The taboos placed upon landforms are usually enforced by beliefs about the existence of spirits. This spiritual existence brings about fear in the people so that, any respect shown to a sacred landscape is done out of fear. The people of Kinene and Zaukave believed that in such circumstances, the sacred landscapes can only be entered by the rightful land owners because the spirits know them and will not harm them. This was emphasised by a Kinene adult, "if an area is considered taboo, only the owners of the land will go and use that particularly area" (K6, 3). Such belief indirectly controls the access of the forest areas by permitted persons and this leads to the protection of that particular area.

The recognition of spirit beings is an indication that the Kinene and Zaukave people acknowledge another world that co-exists with their physical world and that is the spirit world. The implication here is that the environment can not be considered only in the physical sense but also needs to be understood in the spiritual sense as well for one does not exist without the other.

4.3.3 Sustainable Forest resources

The rainforest, like other habitats of the world, is a home to vast numbers of species of plants and animals. Every biotic and physical component of this habitat is known to the people who have land rights to it. In describing the Pual River Basin people of Sandaun Province in Papua New Guinea, Sillitoe (2000, p.148) stated that “ the people have a sophisticated understanding of the plants and animals in their forests”. The forest knowledge is complex in that it requires being knowledgeable about many aspects of plant and animal interactions, seasons, locations they appear, and their uses and importance to the people sharing that forest environment. This is also true for the Kinene and Zaukave people who demonstrate a special knowledge of their forests and the variety of resources the forests provide for them such as food, medicine, clothing and building materials. In addition, the knowledge that every plant and animal that is found in their forests could be classified in one group or another is a bonus as it makes identification easier. The following subsections discuss the resources the Kinene and Zaukave people obtain from their forests.

4.3.3.1 Useful resources

One of the most important resources the forest provides for the Kinene and Zaukave people is building materials. Without trees the people of the two villages would be helpless as all their traditional building materials as described in section 4.3.1.4 are obtained from plants in the forests. Trees of all types occupy the rainforests from different varieties of hardwood and softwood to fruit trees. The hardwood trees, such as oaks and corkwood (*Euodia elleryana*), are used as posts for the houses and fences in Kinene. As pointed out by a Kinene adult, “*Euodia elleryana* is used for constructing the frames of the house” (K3, 1). In Zaukave eucalyptus and introduced pine trees are commonly used for fencing as well as housing. Eucalyptus and introduced pine trees are used in Zaukave because these are trees that people can easily plant. Due to the reasons described below, people do not have free access to hardwoods from the remaining forest and have to grow their own instead. Other plants such as bamboos are used for the walls. The cogon grass (*Imperata cylindrica*) which is often obtained from old gardens is used for the roofs. Varieties of vines and lianes including rattan cane are used as tie ropes.

It is important to note that the only untouched forests left in Zaukave are the ones located on the summit of the conservation park as well as within the park. This is not easily accessible because of the distance from the village and the laws of the park prohibit unauthorised cutting of trees. With these restrictions placed upon the people, they are forced to seek alternative resources. As a result, they either plant non-native trees from which they can harvest later or if they urgently require timber and don't have their own trees, they buy from elsewhere. The implication for conservation is that native species around the village area are declining and need to be replanted. On the other hand, wildlife and native vegetation are replenishing in the forests within and above the park area because it is protected.

The second group of plants that are useful to the Kinene and Zaukave people are those obtained for food. This includes the highland breadfruit (*Ficus dammaropsis*), variety of pandanus such as screw-pine nuts (*Pandanus brosimos*), wild berries such as mulberry, sugar fruit and nuts such as football fruit (*Pangium edule*). The student focus group from Kinene expressed that, "we collect wild fruits and nuts such as *Pangium edule* and mushroom from our forests for food" (Kstd, 1). The villagers, who have land rights to the area, have a sound knowledge of the location of these food plants, their flowering and fruiting seasons. This local forest knowledge is very useful for the Kinene and Zaukave villagers because they use this to plan their cultural calendar of events which would often include planting and harvesting seasons.

The third group of plant resources obtained from the forests are ones used for weaving string bags and clothing or artefacts. In Kinene several types of trees have barks that are useful for these purposes. For instance, to make yarn for weaving string bags, a particular tree bark is removed and beaten until it splits into fine fibres which are then dried before twisting into a yarn. The yarn is then woven into string bags. One female Kinene adult described this process when she talked about her experiences:

My mother used to teach me to peel the bark of this special tree, split and dry it and then remove the fibres. After that, I twist it into yarn using my hands and the surface of my lap. Once the yarn is made then it is ready to weave the string bag (K4, 2).

A useful observation I made in string bag making is that the designs depicted certain objects from the environment such as plants or the landscape. In Zaukave, woollen yarn is used more frequently for string bag making because it is easy to purchase these from the trade store. A second reason is because of the time spent on making fibres from barks which is quite long. The women often find this time consuming. In addition, the decline in the particular plant species in the area is another reason for opting to use wool. Further discussions on the changing use of resources are discussed in section 4.3.5.

Other artefacts made from plants and used for cultural events include grass skirts. Grass skirts are made from leaves of wild palm trees, wild bananas and pandanus and are mostly used by women to wrap around their waists as skirts. Some grass skirts are woven using plant fibres and possum furs. These types of grass skirts are often thick and last for many years. Plant resources are vital sources of building materials, food and costumes and artefacts for cultural reasons. Sustainable use of plant resources will ensure that more is available for later use.

Similarly, animal resources are also plentiful and are mostly obtained for food and cultural reasons. The use of animals as food sources had already been discussed in section 4.3.1.3 however, for cultural purposes animal body parts are mostly used. For example, plumes and feathers of birds are used for headdresses. The furs of small marsupials are used in grass skirts as well as body covering. This was emphasised by the Kinene student focus group who said that “for cultural ceremonies, particularly for traditional dancing, we decorate ourselves using cassowary plumes, bird of paradise plumes, cockatoo feathers and hornbill feathers” (Kstd, 2). A Kinene adult also added that “animals provide us with furs and feathers for decorations” (K2, 1). This was summarised by the Zaukave student focus group as:

We use feathers from parrots and birds of paradise for headdresses. We also often use plants such as crotons and other decorative leaves. Fur from small mammals such as possums and tree kangaroos are often used as well (Zstd, 3).

Apart from plants and animals, other resources are also provided by the physical environment and include fresh air, water and fertile soil.

For instance, four of the thirteen adult interviewees stated that their forests environment provides them with fresh air to breathe. As indicated by a Zaukave elder “when I’m in the bush I breathe in the fresh air and am usually happy” (Z1, 1). This was also echoed by a Kinene adult that “usually when we are in the village and the sun is very hot, we often go into the bush to get fresh air” (K6, 1). The above views illustrate the Kinene and Zaukave people’s understanding that the forest is the source of this fresh air. That is, the presence of the forests results in the production of fresh air.

Another resource provided by the physical environment is fresh water. A Kinene adult stressed that, “without the rivers and streams we won’t have water to drink” (K2, 1). Fresh drinking and washing water is essential for life and is provided by the physical environment. The people demonstrate an understanding that clean safe water is related to the forest. Thus if the forest is harmed, then the water becomes polluted and unsafe to drink.

The Kinene and Zaukave people also perceive that the structure and shape of the mountains enable rivers and streams to flow. This was pointed out by a Zaukave adult that “mountains are good because they enable rivers and creeks to flow through them which gives us freshwater to drink” (Z3,1). Another importance of the mountains is highlighted by this statement from a Kinene adult that, “if we didn’t have the mountains and trees, we would not enjoy the cool breeze and fresh air” (K6, 1). This also illustrates their understanding that mountains are involved in the production of breezes. This is consistent with the scientific knowledge of mountain and valley breezes.

In addition, the Kinene and Zaukave people consider fertile soil provided by the physical environment as vital for planting their crops. This is again emphasised by a Kinene adult, “without fertile soil, we couldn’t plant our crops” (K2, 1). The importance of soil and its role in recycling nutrients and plant support is also acknowledged by the villagers. This illustrates the interdependence of the people and everything within their environment and how these are all connected.

The above points highlight the importance of the physical environment in the two villages as the people tend to appreciate the array of resources provided by their forest environment. Not only are these resources vital but that they are also protected by ancestral beliefs and practices as well as through sustainable use of resources.

4.3.3.2 *Sustainable practices*

Indigenous peoples such as the Kinene and Zaukave recognise the value of their forest resources and have over many generations taken measures to protect them. Their traditional life-styles which have evolved over hundreds of years have developed practices that deliberately set out to conserve these resources. This includes seasonal hunting and harvesting, giving special protection to certain species that are important to the community and harvesting only what they need (sustainable harvest).

Seasonal hunting and harvesting occurs in certain times of the year. These seasons are closely monitored by the local people as the changes in nature are constantly observed. For example, in Kinene the blooming of the flowers of a certain tree signals the season of the wild fowl (megapode) eggs. This is further explained by a Kinene adult:

My people learnt to live with nature by studying weather patterns, animal behaviour, and the different time of the year that various wild fruits and berries blossom, even what animals were plentiful when a

certain plant was flowering. For example, there's a particular tree in this area with pink flowers. When it blossoms, we usually link this to the season when the wild fowls would lay their eggs (K2, 1).

As these people do not keep written records of climatic patterns and animal movements, they depend entirely on the physical changes in nature that signal an approaching change in season. These seasons are also observed by wild animals who respond accordingly. For example, some animals monitor the fruiting season of certain plants and would roam the forests in search of them. In Kinene, cassowaries are said to be popular fruit seekers and roam the forest in search of their favourite fruits when these are in season. As explained by a Kinene elder:

There are a large number of animals living down there towards the Whagi, where the rivers meet. Usually they follow the fruiting season. When certain fruits are in season up in the hill tops, the animals travel up there then return to the river (K3, 3).

With the cassowaries and other animals foraging the forests for seasonal food, they create an opportunity for the hunters to hunt them. That is, as the animals follow the route of their seasonal food, it is easier for the hunters to locate them by tracking them to these fruit trees and shooting or capturing them. As food is plentiful, greater numbers of animals will be out looking for their favourite food so the chances of capturing one becomes high. This form of hunting on a seasonal basis encourages people to hunt a certain animal at a certain time of the year when they are plentiful. Although seasonal hunting contributes to sustainable practice, it is unintentionally done and so it is a form of indirect sustainable practice. For example, in Kinene, wild fowl eggs are harvested at a certain time of the year while in Zaukave, screw pine nuts are also harvested during at a particular time of the year. Seasonal harvest of fruits and eggs encourages people to harvest these foods only at the time of the year they are plentiful. This is, again, an example of indirect sustainable practice.

4.3.3.2.1 *Special protection*

The findings of this study revealed that certain beliefs held by people have prevented some animals from being killed for food. These beliefs are both spiritual and religious in nature and indirectly contribute to the protection of certain species. For example, a religious belief that has influenced Kinene people's decisions on what they should and should not eat is the belief about four legged animals as explained by a Kinene adult:

.....the church doctrines have prevented us from eating all the bush meat we can find. Nearly most of the school aged children, young people and adults do not eat four legged animals, such as tree kangaroo, opossum, and echidna. The church says that these are unclean, even other animals such as lizards, frogs, etc. There is an influx of these animals in our village because of this (K5, 1).

This religious belief of the Seventh Day Adventist (SDA) Church had succeeded in discouraging consumption of four legged-creatures in the Kinene forests. As a result, the species in this category such as mammals, amphibians and reptiles in Kinene forest are not hunted and thus increased in numbers. The SDA religion has a long history with Kinene and other villages of the Crater Mountain Wildlife Management Area (CMWMA) as it entered the area in the late 1960s (Ellis & West, 2004). Since then its doctrines have influenced the Kinene people a great deal and have played a major role in determining what the people can and cannot eat, indirectly leading to the protection of certain species.

In the case of Zaukave, the demands of the conservation park laws prohibiting hunting and the long distances one has to travel by foot to get to the remaining forested areas have forced the people to look for an alternative source of meat. This had resulted in a decline in hunting practices in the area. This was stressed by a Zaukave adult that:

....people are now able to purchase frozen and canned meat of all types from the shops in town. If there was a feast, then it was more convenient to purchase cartons of frozen meat as this is readily available (Z3, 2).

The proximity of Zaukave to the town has also enhanced their demands for alternative protein source and drew them away from bush meat. The local people's action has indirectly contributed to the protection of certain species such as "the blue-black bird of paradise with two long tail feathers (Princess Stephanie's Astrapia), tree kangaroos, and possum" (Zstd, 1).

Cultural and religious beliefs have indirectly led to protection of various species. This has in turn resulted in indirect sustainable practices of resource use.

4.3.3.2.2 *Sustainable harvest*

The practice of harvesting only what is needed is a common practice in Kinene and Zaukave. These practices are consciously done to ensure that there are always sufficient resources available for later use and are a result of past experiences that has forced people to be mindful of how they use their resources. This is described by a Kinene adult that:

..there are so many different plants and animals in the forests but we do not take all of them at once. We take some and leave some. That is, we will only take out what we need (K4, 2).

During hunting, if the hunters come across two animals, they would capture one and spare the other. As described by another Kinene adult "if there are two cassowaries, they would kill one and leave one" (K6, 2). It is this conscious action of taking only what is needed that directly contributes to sustainable use of resources.

An inherent factor that may influence decisions to take only what is needed, is the land boundaries. It is customary for one to hunt and take resources only out of their designated areas. Any violation of this often results in conflicts. As emphasised by a

Kinene adult:

The other factor contributing to people being concerned about their forests is that they are expected to hunt in their own land and obtain everything they need from their own land. This is quite challenging because if they over use certain resources, they cannot get them from another person's land. This has really forced people to be careful and use things from the forest wisely (K5, 1).

Sustainable use of resources is greatly enhanced by clan boundaries and territories influencing people's decisions on how they use their resources. It is vital for Kinene and Zaukave people to continue using their resources wisely as failure to do this may lead to shortage in one's land. Often such shortages may lead to internal conflicts between clan members. The practice of using resources only from one's own land has a direct impact on conservation as it causes people to think carefully when using resources so that they leave some for later. Clan boundaries play a vital role in biodiversity conservation as they determine sustainable harvest and use of resources.

4.3.4 Changing resources

The notion of changing resources in this study refers to alternative resources that the people of Kinene and Zaukave have opted to use. The changes in resource use are greatly reflected in the environmental practices of the Kinene and Zaukave people as it is in these practices that most available resources are utilised.

4.3.4.1 Changes in hunting

The findings indicated that hunting is not regularly practiced by the Kinene and Zaukave as it was in the past. One reason is the influence of religious beliefs which has placed restrictions on what people can and cannot consume. As in the case of

Kinene, the restrictions on the consumption of four legged creatures have left the people not much option but to hunt only birds. This is described by a Kinene adult:

Hunting is not as common as in the past because most of us worship with the Seventh Day Adventist (SDA) church whose doctrines prevent us from eating four-legged creatures so that kind of restricts us to feed on birds (K1, 3).

This restriction has also resulted in the people looking for alternative source of protein particularly, frozen or canned meat. As indicated by a Kinene elder, “nowadays, people are often able to buy cartons of frozen meat from the town for feasts so it does not put much pressure on hunting” (K1, 3). The desire to eat other types of meat apart from bird meat and the declining effect on the hunting pressure on bird species has caused the Kinene people to find alternative meat sources, which is frozen or canned meat.

In the case of Zaukave, the decline in hunting and the decision to purchase alternative sources of protein has been expedited by three factors. Firstly, the distance one has to travel to the forest for hunting. With the only remaining pristine forest located on the summit of the conservation park, it is too far for a hunter to travel and spend a cold night in the forest just so that they can hunt an animal. This was echoed by a Zaukave elder, “people are not interested in spending cold nights in the forests when they can easily buy meat from the supermarket” (Z2, 2). The option to purchase meat is far better than spending a cold night in the forest. Secondly, Zaukave’s proximity to town has provided the people with a greater choice from the shops and markets. They could purchase frozen or canned meat from the shops or live domesticated animals from the markets instead of hunting. Thirdly, parts of the Zaukave people’s hunting grounds have been given away to form the conservation park. The laws of this park restrict access by the local people thus preventing any form of hunting. As a Zaukave elder adds, “part of our hunting ground has been allocated to the park so this has also restricted our hunting areas” (Z1, 2). This therefore adds to the reasons for purchasing alternative sources of protein instead of hunting.

Another reason for the change in hunting practices in both Kinene and Zaukave is the lack of interest by the young people. This is described by one Kinene adult, “young men today do not want to hunt animals” (K2, 3). They would rather spend their time doing something more amusing like sports than waste their time in the bush hunting. This lack of interest shown by the young men is indicative of the changes around them that are having an impact on their choice of activities.

With the changes in the hunting practices has come the change in the choice of hunting tools. In Kinene, while hunters used to use only bows and arrows for hunting, they are now using guns. As indicated by this Kinene adult, “the tools used for hunting are mostly bow and arrow but these days, they often use home made guns” K6, 1). The Kinene teacher added that, “hunting is still practiced today. The hunters use their bows and arrows, dogs or shot guns for hunting” (Kt, 3). The inclusion of guns is indicative of the changing need for a more accurate hunting tool to avoid missing the target. As hunting is less frequent than was in the past, hunters find it more useful to be able to catch their prey in the first attempt. Thus the use of guns is more accurate for this purpose.

4.3.4.2 Changes in gardening practices

Changes in gardening practices are also evident in Kinene and Zaukave. For example, in Zaukave, they are not able to practice slash and burn techniques because of the limitations on their land boundaries. Instead, they practice crop rotation more often as indicated by this statement from a Zaukave adult, “nowadays, we don’t cut new gardens; we just rotate the crops in the old garden” (Z5, 2). Crop rotation is more convenient in Zaukave because they do not have to continue cutting a new garden every so often as they do not have a lot of forest area left to do that.

Changes in food production are also notable in Zaukave - whereby in the past they produce sufficient crops for their own consumption, nowadays they produce a surplus so that they can sell the extras at the town markets. Moreover, imported vegetables such as broccoli, cabbage and carrot are also produced in large quantities solely for sale. Selling of excess garden produce brings in the much needed cash for purchasing store goods such as soap, cooking oil and frozen or canned meat. In

addition, any old garden land that is not cultivated for food crops is replaced by coffee. This is because coffee is a major cash crop that brings in additional cash apart from the garden produce. A Kinene adult attempts to clarify this:

Sometimes we slash a previously fallow area and plant coffee. When the coffee grows 3 or 4 leaves, we usually plant other vegetables with it so that this will enable us to control the re-growth of weeds and grass. Once the crops are ready, we harvest them and leave only the coffee to grow (K2, 2).

There has also been a major change in the amount of time budgeted for various activities. Due to the cash value of coffee, it has taken up more time than activities like gardening and hunting. One Kinene adult describes this by saying that, “coffee takes up most of our efforts these days. We spend a lot of time in our coffee plots because it has become our major income earner” (K2, 3). The amount of time given to coffee is indicative of its importance in the villagers’ livelihood.

4.3.4.3 *Changes in construction*

The study also revealed that there is a changing use of resources in the materials used for construction as well as the construction techniques themselves. For example, in Zaukave, there is an increasing need to purchase construction materials from others as people are not able to get them easily from the forests anymore. Trees required for posts are bought from others if the constructor does not have them. Even bamboos and cogon grass has had to be purchased from those who have surplus. This is indicated by a Zaukave adult:

The materials have always been easily obtainable so our parents and forefathers built this kind of house. Unfortunately, I can’t say the same these days because nowadays we have to pay for these materials if we want them. Unless we have planted them in the past, we can’t harvest them now (Z3, 2).

The people in Zaukave have attempted to address the issue of material shortage by

opting to build semi-permanent and permanent houses. This is so that they will not be bothered by the need to change rotting bush materials which have become difficult to obtain freely.

In Kinene, changes in construction are evident in the type of houses built. In the past people were only able to build round houses but nowadays they are also building houses on stilts. This choice of house is reinforced by external factors such as religion for health reasons or by seeing how people in other parts of the country build their houses which has motivated the Kinene people to do the same.

Another common change in construction practices is the use of pig wire for erecting fences instead of bamboo and cane grass in Zaukave. This is because metal wires will not rot and do not need to be replaced as often as bamboos and cane grasses. This change is again because of the shortages of traditional building materials as highlighted above.

4.3.4.4 Changes in forests resources

Changing resources are also evident in the alternative use of other resources. For instance, what may have traditionally been made of plants and animals has now been replaced with synthetic or factory made products. For example, traditionally, string bags have been made from plant fibres but these have now been replaced by factory made yarn or wool bags. This is the case with Zaukave women who have now opted to use woollen yarn purchased from the shops rather than prepared fibres from plants because it has become difficult to obtain the plant fibres. This is described by the teacher from Zaukave:

In the past we used to use plant fibre but it has become difficult to obtain it so we don't use it anymore. Also, the whole process of producing fibres which need drying and twisting into yarn is too demanding. In the present time, it's easy for us to purchase wool from the shop and weave our string bags (Zt, 2).

People purchase materials because they don't have them anymore or cannot easily obtain them from their environment. Since many don't have paid employment, they use money obtained from the sale of coffee and food at the market to purchase these materials. In Kinene, the use of plant fibres to weave string bags is not a problem because the trees needed to obtain fibres are easy to find. There is however, some indication of younger women using factory made yarn to weave their string bags.

The above examples emphasise the importance of the changing use of resources due to evolving practices and the demands on the availability of vital resources. It is also indicative of the need of the Kinene and Zaukave people to keep up with the changing demands of the world around them. The demands placed upon the Kinene and Zaukave people are a combination of those imposed by other factors such as religious beliefs as well as those that are self-imposed such as the need to build a permanent house so that one does not continuously worry about replacing rotting cogon grass roofs. The Kinene and Zaukave people are obliged to keep up with these demands because their practices are changing and the types of materials they use are also changing. In order to keep up with these changes happening around them they must also make changes to the type of resources they use or skills they practice.

4.3.5 Summary of IEK

The indigenous people of Kinene and Zaukave possess indigenous family knowledge that is essential for land inheritance and clan identification. It also showed that gardening, hunting and construction are common environmental practices that demonstrate the application of indigenous environmental knowledge. These environmental practices promote sustainable practices and land use and minimal use of resources.

The people of Kinene and Zaukave possess rich in forestry knowledge that demonstrates their understanding of natural resources and the need to utilise them in a sustainable way. Spiritual knowledge and belief systems held by indigenous people form their world views and environmental attitudes and beliefs. The study showed that changes in the use of resources are often triggered by self or externally

imposed demands to meet changing needs. These changed practices are not always based on traditional IEK and there are concerns that this may lead to the loss of this knowledge system.

4.4 Indigenous Education Systems

In the context of this study, indigenous education refers to all processes involved in the sharing and exchanging of skills and knowledge related to indigenous environmental knowledge (IEK). These cultural practices are relevant for the survival of indigenous people so if elders intend to pass this to the next generation, it is vital for them to disseminate these skills and associated knowledge.

The informal nature of indigenous education (IE) enables the teaching and learning processes in IEK to be flexible and occur in different settings depending on the nature of the activity administered. IE requires a holistic approach of learning involving the learner's physical, mental, emotional and spiritual capacities (McGregor, 2004), by focussing on skills acquisition in the technical aspects of activities like gardening, hunting, house and artefact making.

This section discusses the various skills type acquired by learners; the teaching and learning approaches used in disseminating these skills including the type of instructions given, who gives the instruction and where learning occurs; and includes the people's views on the relevance of Indigenous Environmental Knowledge in the formal school curriculum.

4.4.1 Gender and age-dependence of skill training

The findings of this study revealed that skills training in Kinene and Zaukave is gendered whereby certain skills are taught to boys and men while others are taught to girls and women. The skills that are predominantly male include hunting and construction. Those that are female oriented include gardening, weaving and domestic skills. As pointed out by a Zaukave elder, "generally men are taught skills that involve hard work such as house building, fence constructions, making bows

and arrows, and making drains in the gardens” (Z2, 2). Another Zaukave elder added that:

Just like men, women also learn some specific skills that are intended for them to carry out their duties efficiently. These include weaving skills for weaving strings bags of all sorts, gardening skills that involve planting of certain crops such as yams & sweet potatoes, and skills in rearing animals (Z1, 3)

Gender based skills are practices of the past but continue to be significant today and most of the tasks performed in Kinene and Zaukave are still based on this way of life. It is these communal lifestyles of the Kinene and Zaukave people that have contributed to the selection of skills that the male and female members of the communities learn and perform for the benefit of their families and the community at large. In addition, the skills learnt are also related to the kind of task each gender is expected to perform. For example, in order to construct a house, boys and young men must learn the skills involved in building one. They may then use these knowledge and skills to build a house on their own.

With the gendering of skills, the learners do not have a say on what they want to learn as this had already been determined by the generations before them. For example, skills in hunting and constructions are expected to be learnt by the male gender while gardening and weaving are to be learnt by the female. There are a few exceptions however, where some women are forced to learn the skills intended for men and vice versa. These are caused by unforeseen circumstances such as the death of their spouses. For example, a female Kinene adult shared that, “I can also do all the gardening processes including erecting a fence around my garden” (K4, 2). Although fence construction is considered a man’s job, this female adult had taken it upon herself to learn the skills and perform the construction work because of the loss of her husband meant that no one else was going to do it, so she had to teach herself to protect her garden. In this case, it is the situation that had forced her to make the choice to learn fencing skills.

Apart from these, some practices such as gardening have different stages at which men are required to do certain tasks while women do the others. In such situations, the men need to know the skills involved for the particular task assigned to them. For instance, in Zaukave, before the women make sweet potato mounds, the men are required to make the drains first. As indicated by this Zaukave adult, “drains are made by men to remove excess water so that crops don’t get drowned (Z3, 2). In this situation, drain making requires the special skills of handling the spade correctly and digging in a consistent manner to make the drains in a straight line. It is anticipated that the men are able to handle the spade well because they have a good strong grip and can manoeuvre the spade in a manner expected to produce the best result.

Other skills are also learnt by both male and female but used for different purposes. For example, in both Kinene and Zaukave some men also know how to weave. However, the activities involved in the actual application of the weaving skills, may differ. For instance, the men use their weaving skills for constructing bamboo walls while the women use theirs for weaving string bags. As described by a Kinene adult, “only a few men are taught weaving skills so that they can use this for weaving bamboo walls for the house” (K4, 2). One reason for involving men in this process is because working with bamboos can be a messy job. When bamboos are split, they have sharp edges which can cut a person if not handled carefully. Thus men are believed to be able to handle this task much better than women. In addition, while the bamboo is partially completed, it is raised against the frame of the house so that as the men work on it, they can also be able to estimate the amount of material needed to complete the walls. This can be an untidy job and requires strength to handle it carefully so as not to hurt themselves. In this context, the kind of skills acquired may also depend on the type of activity involved as some tasks can be handled better by men while women handle others better.

In all, the types of skills learnt by learners are pre-determined by their gender as had been the practice over many generations. Nevertheless, skills are learnt at various stages throughout a person’s life. In Kinene and Zaukave, skills’ training is given through different life stages. For example, the boys learn to make bows and arrows

at an early age as indicated by this Zaukave adult:

Usually for boys, skills needed to construct bows and arrows and other general knowledge about plant and animal life is introduced to them by six years old. This is so that as they grow older, they learn to improve their basic skills (Z3, 3).

The girls also undergo a similar learning process whereby they are taught general knowledge as well as specific task related skills such as weaving and planting. It is also anticipated that by the age of nine years, the girls should know the basic procedures and skills of weaving a string bag. For example, as described by a Kinene elder:

...weaving skills for string bag making can be taught to girls at about the age of nine years or more. This is because they can now be able to confidently twist the fibres together to produce the yarn for weaving the string bags (K1, 4).

Gendered skills training is practiced in both Kinene and Zaukave although there are some skills that are learnt by both genders as discussed above. Moreover, various skills are also taught to the learners at different stages of their life so that through practice and trial and error they can improve their skills.

4.4.2 Teaching and learning

The nature of indigenous education (IE) enables it to be taught through a real situation thus expanding the realm of learning beyond speculation (Simonella, 1997). It favours the principles of direct experience and learning by doing (ibid). With the focus of IE on the daily livelihood of the Kinene and Zaukave people, learners informally learn through their direct experiences by observing and imitating their elders at work and then personally practicing the skills through trial and error. This is exemplified by the following quote from a Zaukave elder:

Usually, if I was learning a particular skill, the person teaching me would show me what to do first and then he would attempt to drill these skills into me. I will in turn trial out these skills or knowledge by practicing until I master it. In fact, I had to keep trying out the new skill or knowledge until I mastered the skill or verified that the piece of information about something I learnt, can work. It's like I have to keep trying it out until I become good at it (Z1, 4)

Another Zaukave adult also added that, “teaching and learning is orally done but learners are expected to observe, trial and practise until they master the skills and knowledge” (Z3, 3). This was also echoed by a Kinene elder:

The learners would often be drilled on a skill or knowledge by observing the instructor doing it and trialling it at the same time. The more practice they have in trialling, the better they become at it and eventually master the skill, art or knowledge. (K1, 5)

What is evident here is that learning in indigenous education involves a prolonged period of observation by the learners before they can attempt to trial out any skills acquired on their own. This is followed by another period of trial and error before the learners master these skills.

4.4.2.1 Teaching and learning approaches

Various teaching and learning approaches identified in Kinene and Zaukave have already been expressed elsewhere such as the UN Decade of Education for Sustainable Development teaching and learning strategies (UNESCO, 2006a). These approaches include a lengthy period of skill and/or knowledge acquisition; learning through experience; learning through example, modelling, ritual and storytelling; and, being tested in practical life situations.

Learning through a lengthy period of acquisition is skills based and involves learning new skills such as artefact making. For example, in learning how to make a

string bag, girls and young women are observe their mothers and other female relatives over a lengthy period of time. This is then followed by a period of trialling their skills by attempting to construct one on their own, which is then assessed by their instructors. The instructors provide them with feedback to improve or maintain their performance. This is described in this quote by a Kinene adult:

...my mother told me to twist the fibres to make yarn and I had to try it. I watched her do it a number of times and then I practiced doing it. The first time, I made mistakes and had to remove it a number of times until she was happy that my product was well done. Then she asked me to bring other materials to her and she did the start for me. Then she told me to continue from where she started and have a practice of that which I did. Gradually I got into the swing of things. The first time, the end product was a rough work. But from the second time and onwards, I got the feel of things and became good at it (K6, 2).

In addition, the learning through experience approach involves learning of a new skill in the process of carrying out an actual task. For example, if a learner is involved in erecting a garden fence for a family with his instructor(s), then he is most likely to learn the skills in this construction experience. In this case, he is not only observing but is actually participating in the task underway and in so doing is learning the skills and processes involved.

The approach of learning through example, modelling, ritual and storytelling involves a number of learning experiences. For example, modelling of a skill may involve constructing a creative work such as weaving patterns into the bamboo walls. During the observation of a Kinene elder who constructed bamboo walls, I observed that he wove a wavy pattern resembling mountains. To do this, at certain points he would stop to interlock the bamboo strips in a particular manner to get the desired pattern. Those who were observing had to carefully observe his demonstration at various points during the construction process. Similarly, in describing the initiation ceremony that he underwent, a Kinene adult described the rituals he had to go through to learn various survival skills such as stuffing moss into his nostrils while collecting wildfowl eggs so that he does not inhale the heat from the nests. If he does, then the inhaled hot air may cause him to be stagnant in

his growth. The logic in this practice is that the wild fowl's nests are dug into the ground before being covered by dried leaves and vegetation so that the heat produced is conducive to nurturing their eggs. The temperature in the nest can be quite extreme if someone puts his head closer to it in an attempt to dig the nest to retrieve the eggs. Thus, the stuffing of the nose enables the hunter to put his nose right above the nest without fear of direct inhaling of hot air. Learning through rituals means the learner has had to learn the skills and knowledge in the process of participating in the ritual process.

Similarly, learning through story telling mostly involves learning about indigenous family knowledge such as the history and origin of the local people. As described by a Zaukave adult, "I'm from the Gopamo clan of Zaukave village. My ancestors originate from the Asaro valley. They've lived here for quite a long time; I don't know the exact number of years" (Z5, 1). The elder's knowledge is based on what his father had told him. Such knowledge involving clan history or origin is not written in any form and is told orally through storytelling.

The most difficult approach to learning is by being tested in a real life situation. For example, a Kinene villager was on his way to the village on the other side of the big river and had to cross it. On arriving at the river bank, he found that the river had flooded overnight. As he needed to transport himself and his belongings across the river, he was forced to utilise various construction skills acquired over the years to build a raft that could safely transport him and his things across. His ability to incorporate various construction skills to build a stable raft was a test of his skills. In doing so, the villager may have acquired specific skills in raft making which he did not have before.

The above approaches illustrate their relevance to teaching and learning in indigenous education. Each approach emphasises the principle of learning by doing through direct experiences whereby a learner had to be involved in real life learning process to learn a skill or knowledge. As in the case of skills training, these approaches, although not written down, have been practiced over many generations among the indigenous communities of Kinene and Zaukave, so that learners are

taught about real life situations which require real life skills that will enable an individual to survive in the community.

4.4.2.1.1 Education of indigenous knowledge

Education of indigenous knowledge involves oral history with no form of written instruction about what knowledge is essential for survival. Nonetheless, the local people are knowledgeable about what is vital and has to be disseminated to the younger generation. The findings in this study indicated that such forms of knowledge include indigenous family knowledge, knowledge about plants and animals and other physical components of the environment, and general knowledge necessary for the people's survival.

Nearly all forms of indigenous knowledge are disseminated through oral history by means of storytelling, modelling and rituals. For example, in describing his family origin a Kinene adult described his clan's migration route:

The origin of my clan lies within the Haia village of Karamui district, Simbu province. My forefathers were the first to settle here, well before the white men arrived in this country. That means that they've been here for quite a long time (K2, 1) .

Similarly, in trying to establish the origin of the nearby river in Zaukave, an adult used a myth to tell about how their mountain is said to be the source of many rivers:

There is also a story about a boy who fetched water in a bamboo container and took it to the mountain. There was a bee in this container and he was told not to drink it. He disobeyed and opened the container to have a drink but the bee flew out and stung him. The boy dropped the water container which split and the water poured out in all directions. The local people believe that their mountain is the source of rivers flowing to the north and south of the mountain (Z3, 1).

The different forms of environmental knowledge are also depicted in art form such as the patterns on the bamboo walls and strings bags. In describing the patterns on

her string bag during an observation session I had, a Kinene woman explain the patterns as depicting the popular native pine tree on the local mountains. Similar sentiments were also expressed by the elder who constructed the bamboo walls that the patterns represented the mountains ranges. Other methods of disseminating indigenous environmental knowledge include traditional songs and dance patterns. For example, in a song about nature a Zaukave adult describes the beauty of the waterfall and the lake that radiates the rainbow colours of peace and tranquillity. The song not only describes the beauty of the lake and waterfall but also expresses man's need to be embraced by this beauty. Similarly, the movement in a dance pattern may also exhibit the environmental knowledge of plants and animal. For example, a cassowary dance may depict how cassowary moves on the forest floor foraging for food.

4.4.2.2 Instructions

As mentioned above, instructions given to learners are not written down in any form. Often instructors may decide to give verbal or non-verbal instructions depending on the nature of the activity and skills involved. Most often instructors see no reason for any verbal explanation so they would work quietly and expect the learner to observe closely. This is illustrated in this statement by a Kinene adult, "I watched her do it a number of times and then I practised doing it" (K6, 2). In this situation, there was very little verbal explanation exchanged for the learner was expected to observe closely before making her own attempt at the string bag making skills demonstrated. If an instructor chooses this mode of instruction, then the learners must make every attempt to observe closely and imitate the instructor. This is because in a communal society such as Kinene and Zaukave, it is considered rude to question one's elders especially in the situation where the instructor is an elder from one's clan or immediate family.

In some instances, most of the information dissemination is done verbally with no written instructions for the learners. This is illustrated in this statement by a Zaukave elder, "the learners are shown how to do something and at the same time the instructor verbally explains the procedure" (Z2, 3). This was further described by a Kinene elder from his personal experience as an instructor:

If I am showing young people what to do, I would often explain the process to them and at the same time show them how to do it. For example, in constructing a bamboo wall I must first weave it and then put it up against the frame of the house. In this process, I show learners what I've done and explain verbally how it must be put up against the frame of the walls. They then practice it for themselves (K1, 5).

The nature of an activity is often a deciding factor that determines the use of verbal instructions. For example, during house construction, it would be useful to call out names of specific materials required as one expects learners to pass on correct items. In the process of doing this, the learners are also able to identify the different types of timber or other materials used in the construction. On another note, non-verbal instructions are preferred in learning tasks that require learners to use their senses to observe animal tracks, listen to bird calls to identify the bird or collect medicinal plants from the bush. Non-verbal instructions are appropriate where no talking is required, but rather the practical use of all human senses are necessary.

4.4.2.3 *Instructors*

Within indigenous education, the learners do not choose their instructors as it is already determined by the clan or family they belong to. Most instructors are directly related to the learners and consist of parents, grandparents and elderly clan members. As highlighted by a Zaukave elder:

The young boys and men are taught by their fathers and grandfathers and other elderly members of the clan. The same thing applies for young girls and women. They are taught by their mothers, grandmothers and elderly members of their clan (Z3, 3).

The precise instructor for a particular skill training is determined by the nature and stages of the learning process involved. For example, general daily skills like gardening maybe taught by the parents. Other skills such as hunting may require an

elderly clan member who is also a hunter and is in a better position to teach the younger learners appropriate hunting skills. There are also situations whereby a child is raised by grandparents who take responsibility for educating the child in all the required areas of learning. For example, in explaining how they knew how to make bows and arrows, one boy from the Zaukave student focus group said “my grandfather taught me”(Zstd, 3). This particular student further explained that he lives with his grandparents who teach him many things. The grandparents have a social obligation to act as instructors thus they are expected to perform this task with any child or young person under their care.

From the above examples, it could be said that in Kinene and Zaukave, teaching and learning in indigenous education is a family affair and involves older members of the clan helping in the education of the younger members. Older members of the clan take up the instructors’ roles because it is their sole responsibility to educate their younger kinsfolk on the indigenous family knowledge and practices to safeguard and protect their inheritance. This understanding is also expressed in other indigenous cultures such as the Yupiaq of Canada (Kawagley et al., 1998).

4.4.2.4 Situated Learning

With the flexible nature of IE, learning occurs at various locations where communal activities such as gardening, hunting, house and artefact building occur. The findings of this study indicate that family homes are the central focus of the first learning stages of the learners. This is because the home is where everyone gets together so if children enquire about something, it is more convenient for the parents or grandparents to discuss these issues with them. As the learning process advances, the learners and instructors venture out to other locations where specific activities occur. A Kinene adult highlighted this in saying that, “most of the teaching and learning process took place in the family home. Other things were learnt at various locations where activities were going on like hunting, gardening, and so on” (K3, 4). Another Kinene elder also stated that:

This would usually start in the family home but continue to
different locations at which various activities or tasks are carried

out. For example, if a house is being constructed by a relative, then it is an opportune time for the boys and young men to be drilled on the skills (K1, 5).

To learn a particular skill, it is logical to learn it at an appropriate location. For example, to learn the proper skills of taro planting, girls and young women had to be shown how to do it correctly at the taro garden. Similarly, to learn to construct the frames of a house, young men and boys had to be shown this at a house construction site. The flexibility of the locations allowed for flexibility in the learning process thus making learning more realistic for the learner instead of more abstract.

In addition, the types of tools the instructors used in the teaching and learning processes depended on the nature of the activities being taught. For example, during the construction of a classroom building in Kinene, I observed that all necessary tools including building materials were provided at the site. The useful thing to note here is that the tools are varied and include things one may find in their environment such as bamboos and trees.

4.4.3 IEK and the curriculum

The holistic view of indigenous education (IE) to develop the learner's physical, mental, spiritual, and emotional capacities enables learners to do so without fear of intimidation. These different learning capacities are aimed at being developed during any one task that learners are expected to do. For example, in string bag making, the emotional capacity of the learner is developed in her appreciation of the beauty of her product. Similarly, her physical and mental capacities are met when she considers the width and length of her bag as well as the length and spacing of each of the fibres that are interwoven to produce the bag. The type of design she weaves on her bag addresses her spiritual capacity to identify with and connect to the object depicted in her design. This was illustrated in the observation I had of the woman who was weaving the design of the native pine tree onto her bag. Her explanation why the native pine was conspicuous on the mountain range in her design was a demonstration of her ability to identify with this tree as belonging to

the same mountain or forest. The need to belong to or with something is the illustration of the spiritual connection one has with their environment. The underlying point is that the teaching and learning approaches have unintentionally integrated various learning capacities of the learners in ensuring that what they learn is holistic.

In IE, the learner is given recognition depending on individual abilities and allowed the lifelong opportunity to perfect the various skills they have learnt. There is no pressure exerted on the learner to achieve the skill or knowledge immediately because it is up to them to learn it. This was expressed by a Kinene adult, “if you made a mistake then you would remove it and do it again. This enables you to learn from your mistakes and become good at it” (K4, 3). The inability of a person to perform a particular skill is enough evidence to another person that one has not learnt or mastered the skill and would therefore require assistance from other people. Thus, the learner takes it upon themselves to master the skills in their own time.

The ability of IE to encourage development of individual learning capacities has been recognised by older members of the clan who have expressed concerns about the relevance of learning indigenous environmental knowledge (IEK) in the formal school curriculum. As indicated in the concerns raised by a Zaukave elder:

One thing I want to add here is that teaching and learning in schools must be done in the local dialect (Alekan). There is this issue of identity. When we learn things and exchange ideas in our own dialect, it gives us a sense of identity and unity (Z2, 3).

A Kinene elder also shared similar sentiments that:

It would be good to balance western education with our own indigenous education. Children must learn about how our forefathers lived in their environment and this should be seen as an opportunity to learn about our indigenous ways of doing things too

(K3, 4).

The above excerpts illustrate the importance of language and indigenous family knowledge as a display of cultural identity. This strengthens the bond one has with the past and links it to the present. Such information was seen as valuable and useful for the learner to identify with. Other adults in Kinene and Zaukave also expressed concerns about the importance of the indigenous knowledge and how it should be continued to uphold the dignity and identity of the indigenous peoples concerned.

The elementary school curriculum in Papua New Guinea is designed to be contextual building on knowledge the children already have in their own language and culture (Marimyas *et al.*, 2003). The teaching approach is based on integrated units of work focused on themes to be taught for one to two weeks. As a community curriculum, it is aimed at promoting knowledge, skills and attitudes that the community wants their children to learn. This revolves around the community calendar of events which provides the basis for the teaching programs. What the teachers may lack in the actual implementation of their teaching program is sufficient teaching time and ability to incorporate outdoor activities into their lessons with an integration of indigenous environmental knowledge (IEK). For example, during the interview with the Zaukave teacher, I enquired if I could observe an environmental lesson but the teacher responded that “I have programmed a gardening lesson but will not teach an outdoor lesson instead, we will do a simulation on gardening in the classroom” (Zt, 2). While this topic required an actual outdoor activity that may have shown students’ involvement in constructing or observing the tending of an outdoor garden, the teacher had restricted them by foregoing the outdoor activity. The inability of the teacher to incorporate a practical outdoor lesson would be seen by the community as a failure of the formal curriculum to address skills and knowledge relevant to IEK. For example, a Kinene adult expressed concern that “the schools should teach some of the basic environmental skills that were useful to our people in the past. This will prepare the children to use these skills when they return to the village” (K4, 3). Another Kinene adult also stated that “I think some of the important skills related to

observation of nature or identifying useful plants should be taught to students. This is so that they don't miss out on learning about life in the village" (K5, 3). The difference between the formal curriculum and IE is clearly evident in this excerpt from the Kinene student focus group, "what we learn at home is different in the sense that it is more practical such as hunting skills. The teacher teaches us about writing, reading and art which are often not very practical to us" (Kstd, 3). The children are able to distinguish between the kinds of skills and knowledge taught at home and in the school because what is taught by the teacher is considered abstract so the relevance to practical living is not realised.

The relationship between environmental knowledge and skills learnt in IE and the formal school curriculum has been recognised by the adults and student focus groups in both Kinene and Zaukave. The need to continue disseminating Indigenous environmental knowledge (IEK) in the formal system will ensure that IEK continues to be taught and learnt. Also the realisation that the formal school curriculum is drawing young people away from their IEK by teaching about abstract things that are not applicable in the society is a concern for the adult generation. The adults and elders have also seen the importance of incorporating IEK into the formal school curriculum to ensure that the present generation does not miss out on learning IEK which is also applicable to their lifestyle.

4.4.4 Summary of IE

Indigenous education (IE) has a long history amongst indigenous people such as Kinene and Zaukave. This is because through the informal teaching and learning in IE, relevant lifelong skills and knowledge were passed down the generations. The following summarises the findings of this study on IE in Kinene and Zaukave communities.

In addressing the informal nature of IE, skills and knowledge training in Kinene and Zaukave has attempted to take a holistic approaches in developing learner's different capabilities. With this approach in Kinene and Zaukave, it was revealed that the skills training is predominantly gendered with males learning certain skills

and females learning others. Although, some skills such as weaving are learnt by both gender but used to perform different tasks. In addition, different stages of skills training are taught to learners at different ages. Skills training are a lifelong process and that an individual continues to acquire skills and knowledge that are perfected throughout their lifetime.

The teaching and learning approaches in IE are based on the principles of direct experience and learning by doing and so provide a realistic learning experience for the learners. The learners are involved in a period of prolonged observations which lead to a period of trial and error, providing them with the opportunity to perfect their skills. Much of the teaching and learning involves oral history, although instructions given to the learners can be verbal or non- verbal depending on the instructor and the nature of the skills involved.

Due to the nature of IE, the instructors involved in the teaching of the skills are mostly relatives of the learners such as parents, grandparents and clan elders. As learning begins at home, it is appropriate to involve the immediate family and clan members. It is also useful to note that these adults have a social obligation to educate their children or younger members of their kinsfolk to ensure that knowledge and skills are disseminated and continue to be passed down the generations. Moreover, with the flexible nature of IE, learning can take place anywhere at any time depending on the skills being learnt. These locations range from the house to the garden and the forest. In addition, tools used in aiding the teaching and learning process are very much depended on the type of activity administered. Real objects and real life situations including the environment itself are used to emphasise skills and ideas.

The introduction of the formal school systems in the indigenous communities is seen as a threat to teaching and learning of much indigenous environmental knowledge (IEK), skills and practices. The inability of teachers and insufficient time available to include outdoor activities is enhancing the elders' views of the failure of formal curriculum to address IEK. Integration of IEK and the involvement

of elders in the teaching program may encourage a more integrated and relevant curriculum.

4.5 Chapter summary

This chapter provided an analysis of the research findings and discussed the application of indigenous environment knowledge in the environmental practices of gardening, hunting and construction. These environmental practices demonstrated the application of indigenous environmental knowledge. An analysis of the data also showed that indigenous family knowledge is essential in acquiring land and resources in these communities. An analysis on practices based on IEK relating to forest resources illustrated the importance of the IEK and environmental practices and the need to conserve these resources. A discussion about changing in resource use highlighted the need for sustainable practices.

An analysis of indigenous education was provided and highlighted the importance of gendered skills training in IE. Teaching and learning in IE was also found to be flexible, holistic and informal and encouraged learners to learn by doing through various teaching and learning approaches. IE is holistic in nature and is situated in a cultural context.

The next chapter presents the discussion, of the findings and the conclusions. This is then followed with implications for biodiversity conservation and the future research.

DISCUSSION, CONCLUSION & IMPLICATIONS

5.1 Chapter overview

This chapter discusses the findings of this research which comprised a small scale, ethnographic case study. The chapter considers the implications of indigenous environmental knowledge (IEK) and the practices of two tribal groups in Papua New Guinea and the teaching and learning approaches they use in disseminating IEK. The chapter begins with a discussion of the findings in terms of the research questions set out in chapter one. Conclusions are then drawn, followed by the implications of the research findings, and suggestions for future research complete this thesis.

5.2 Discussion of findings

The research questions in this study are related to: (a) indigenous environmental knowledge that may impact on biodiversity conservation in Papua New Guinea and the fundamental beliefs that inform these knowledge systems, with any similarities and differences between the two villages; and (b) various approaches through which these indigenous environmental knowledge systems were acquired, interpreted and passed on to the next generation and the tools that aided these processes. The findings are discussed in the light of the research questions.

5.2.1 Indigenous Environmental Knowledge

As defined earlier, indigenous environmental knowledge (IEK) is the accumulated knowledge and skills of indigenous people and their relationship with the environment (Verlinden & Dayot 2005; Bicker et. al. 2004; McGregor, 2004). IEK is demonstrated through the possession of indigenous family knowledge, the daily environmental practices such as gardening, hunting and construction of houses and

artefacts, knowledge of forest resources, spiritual knowledge and beliefs, and sustainable practices. These knowledge and practices, and changing patterns of resource use, and knowledge dissemination, have implications for biodiversity conservation.

5.2.1.1 Indigenous family knowledge`

The findings of this study revealed indigenous family knowledge as an important source of environmental information possessed by the Kinene and Zaukave people. Being in possession of this knowledge implies two things: (a) land inheritance and (b) clan identification. In the first instance, knowledge of clan origin and migration routes demarcates clan boundaries and territories. Land inheritance includes all available resources, both living and non-living. It is the social obligation of the land owning group to protect these resources so that it continues to sustain their kinsfolk. Conservation is therefore significant at the clan level because clan livelihood is dependent on these resources. In the second instance, family knowledge is linked to clan identification where a person identifies with a particular clan group and seeks to give and receive support from this group throughout their lifetime. Such dependence enhances the strong kinship bonds already held by the groups in the community which extend beyond the immediate family to include others. Biodiversity conservation is vital at this stage because kinship dependence also extends to resource use and lack of these resources may be problematic for them. Irresponsible use of resources by resource owners may lead to problems. For example, with the selling of Zaukave clan lands to other tribes to settle on, clan owned lands could gradually decline leading to a loss of subsistence areas and an eventual loss of relationship of the clans with their environment. Loss of clan lands may mean loss of rights. This may lead to uncontrolled environmental destruction, harming biodiversity.

5.2.1.2 Environmental practices

The findings of this study revealed that gardening, hunting and construction of

houses and artefacts are common environmental practices of the Kinene and Zaukave people. Other studies on indigenous people from PNG (Sillitoe, 1983; Sillitoe, 2001; Waiko & Jiregari, 1982) and indigenous research from elsewhere (Burger, 1990) also emphasise the importance of these practices for the survival of these people. This implies the practices of gardening, hunting and construction is essential for survival among many indigenous communities that still live within their natural environments.

The Kinene and Zaukave people practise shifting cultivation with long and short fallow periods although the latter focuses more on crop rotation to maintain soil fertility. The findings of this study suggest topography, soil type and climate as major factors determining the range of plants that can grow in an area. This is supported by other studies such as Sillitoe (1983). This knowledge is widely applied in the practices of Kinene and Zaukave such as in the construction of drains and earth mounds. An understanding of nutrient recycling and re-growth control is demonstrated by the practice of burning dried vegetation. The people as well as Sillitoe (1983) describe this as a vital practice for the release of nutrients which are otherwise locked up in the vegetation. Both Kinene and Zaukave people have worked their land for many generations and endeavour to do so in the future. Thus the indigenous gardening knowledge illustrated above is useful for continuity. The benefits of these two practices to biodiversity conservation are that nutrient recycling techniques would enable nutrients to be recycled constantly, preventing the need to cut new forested areas to make gardens and hence prevent loss of biodiversity. Similarly, consistent use of fallowing periods will also enable previous garden lands to be cultivated in a cyclic process without the need to clear new forested areas. This practice will promote biodiversity conservation efforts in ensuring continuity of plant and animal species. The indigenous knowledge demonstrated in gardening practices also supports sustainable farming and land use.

While hunting in Kinene and Zaukave is practised for the purpose of obtaining bush meat and other items for socio cultural activities (Sillitoe, 2001; Dwyer, 1982 & Kwapena, 1982), the findings indicate that differences exist in the (a) frequency of hunting, (b) type of animals hunted, and (c) type of hunting tools used. These

differences are prompted by a number of factors including increased alternative meat sources, introduced religious beliefs and imported tools. The study found that Zaukave people are hunting less because of a wide variety of meat choices available to them. This may have a negative impact on indigenous environmental knowledge and practices as there may be a “loss of foraging, hunting and collection skills and craft or manufacturing knowledge” (De'Ath, 1982; p.208). Similarly, introduced religious beliefs in Kinene led to the hunting of only birds. The disadvantage of this practice is that it may result in over hunting of bird species if the people are not careful. A study on hunting pressures in the Southern highlands province of PNG by Kwapena (1982) has shown the possibility of this happening. Nevertheless, the Kinene people have recognised their plight and have opted for alternative meat source. The use of alternative meat source takes pressure away from wildlife and allows them to replenish. This is good for conservation however; lack of practice may lead to the loss of skills and knowledge related to sustainable hunting practices. Moreover, increased use of imported hunting guns is harmful to wildlife. This is unlike the use of traditional tools where the possibility of the animal surviving is quite high if the hunter misses. It is worthwhile to note that traditional hunting practices align with sustainable practices and contribute to biodiversity conservation efforts.

The construction practices of Kinene and Zaukave demonstrate the need for (a) minimal use of resources to avoid wastages and (b) producing durable artefacts to avoid over harvesting of resources. The use of the cheapest available materials from the environment to construct round houses is a demonstration of the need to use minimal resources. In addition, trees and other cleared vegetation are also used to construct fences for new gardens. The practice of minimal resource use is an indirect effort to conserve resources so they can continue to flourish (Waiko & Jiregari, 1982). This is further demonstrated by the production of durable artefacts without the need for frequent replacement. This is illustrated in the preparation process of artefacts such as the use of fire to heat the arrow head. An unspoken awareness exists among artisans who utilise every available resource with little wastage, as well as producing durable artefacts to minimise over harvesting. Such traditional practices are useful in supporting sustainability in the future. The

indigenous people's ability to use small quantities of a wide variety of plant and animal resources as well as to avoid wastage is a significant effort towards sustainable resource management and efforts to promote this should be encouraged. With minimal use of resources and no wastages, trees and plants will not be cut and this contributes to protecting biodiversity.

5.2.1.3 Forest resources and sustainable practices

Resources obtainable from the forest range from plants and animals to fresh air and water. In Kinene and Zaukave, the importance of these resources is even depicted on the artefact designs. For example, during an observation of a group of women weaving string bags, I was informed by two of the women that the designs they constructed represented plants, a cordyline and a native pine tree. The usefulness of the forest resources is determined by how the human perceives them. For example, in a study of the Bedouin people of Sinai, Reiss (2001) reported that in a Gebaliya adult's perspective nature did not have a right to exist unless the human perceives it to be useful. The human perception in this context is important as it determines the purposes of these resources. As forest resources are vital sources of building materials, food, medicine and cultural items, the local people make an effort to know and understand their purposes, hence classification of these resources becomes a useful method of appreciating their purposes and uses. Moreover, the aesthetic quality of forest resources also makes conservation vital because this makes people appreciate and enjoy the forest. Application of forest knowledge is vibrant in Kinene because of their daily encounters with the forest whereas in Zaukave it is declining due to lack of practice. Conservation of forest resources and the reasons for their conservation therefore becomes an issue of concern and should be encouraged.

As Fien (2002) notes, the intimate environmental knowledge of the indigenous people had enabled them to co-exist with their environment over many generations. This co-existence was exhibited by the sustainable practices of the people in ensuring that forest resources were wisely used. This study also revealed that Kinene and Zaukave people have knowingly practised sustainable practices for

many generations. Some of these practices were intentional while others were not. Intentional sustainable practices stemmed from the conscious environmental practices of the people while unintentional practices evolved from indigenous belief systems. Sustainable practices are essential for biodiversity conservation as they encourage wise use of resources.

5.2.1.4 Spiritual knowledge and beliefs

Indigenous spiritual knowledge and belief systems are an important part of indigenous people's lives as these set the basis for their worldviews (Antone, 2003; McGregor, 2004; Narokobi, 1980; Roth & Barton, 2004). These are also instrumental in developing people's environmental attitudes and values (Fien, 2002) which contribute to resource usage. By being in possession of indigenous spiritual knowledge, indigenous people possess spiritual understanding (Kawagley et al, 1998) that enables them to view the world holistically and act to protect it. Spiritual knowledge develops beliefs that are intended to show respect to spirits in fear of being harmed and are demonstrated in taboos or sacred places. Such beliefs gradually lead to unintentional protection of certain species. The findings indicate that belief systems are strongly adhered to in Kinene. The reasons pertain to their location and the lack of influence from other factors such as migrant tribes which may affect the Zaukave tribe. An understanding of indigenous spiritual knowledge and beliefs may be useful in creating awareness amongst resource owners on the importance of sustainable resource management. By linking these spiritual knowledge and beliefs to the past and present environmental practices of the people, they could be made to recognise the value of biodiversity and take actions to conserve them. As Fien (2002) notes, the indigenous belief systems shaped indigenous people's values and attitudes towards their environment and guided their actions making them sustainable.

5.2.1.5 Changing resources

The changes in resource use is self imposed by the people due to resource limitations or externally imposed by other factors such as religious beliefs. Changes

in resource usage are both positive and negative depending on the reasons underpinning its usage. For example, use of concrete and steel in Zaukave to replace limited available bush materials in buildings is favourable as it is beneficial to the environment seeing that it minimises the need to replace rotten bush materials every so often. The less the amount of bush materials obtained from the environment, the less the chances of disruptions caused to the ecosystem. The negative impact of such practice is that people may forget the skills and knowledge involved in sustainable construction practices. In spite of the advantages and disadvantages of alternative resources, indigenous environmental practices that are favourable to the environment should be encouraged as use of alternative resources may have unfavourable impact on availability of biodiversity. It would also be advisable to weigh up the pros and cons of alternative resources against their impact on biodiversity before employing them.

5.2.2 Indigenous Education Systems

As discussed earlier, indigenous education (IE) refers to all processes involved in the sharing and exchanging of skills and knowledge related to indigenous knowledge (IK). IE particularly involves the acquisition, interpretation and dissemination (Sable, 2004) of IK to ensure its continuity in the next generation. This is achieved through various processes and stages in a person's life which is reinforced in gender and age-dependent skill training; various teaching and learning approaches; education of indigenous knowledge; and the relevance of indigenous environmental knowledge (IEK) in formal school curriculum.

5.2.2.1 Gendered and age-dependence of skill training

The findings of this study revealed skills training in Kinene and Zaukave as (a) gendered and (b) age-dependent. Gendered skills training is rooted in the cultural setting of Kinene and Zaukave which emphasises the strong bond of kinship and shared responsibilities. In such communal societies, skills' training is segregated according to society's expectation of what the male and female roles and responsibilities are. This communal nature of Kinene and Zaukave is the cultural

setting within which the learner interacts, hence gendered skills' training is the norm in this context. On the other hand, age-dependent skills training enable learners to acquire certain skills at various stages in their lives so that through trial and error over the years they become skilful. Kawagley et al (1998) reported a similar trend in Canada where young Yupiaq children were very skilful in a variety of tools at an early age. This illustrates their ability to learn different skills at various stages in life and the need to know how to handle necessary tools appropriately. The implication is that age-dependent skill training is useful and enables young learners to master the skills as they mature. The relevance of these gendered skills to biodiversity conservation is that certain skills and knowledge about plants and animals is possessed only by the gender who deals with that feature on a regular basis. It would therefore be appropriate for conservation practitioners to tap into this expertise once they establish the different gendered skills. For example, in Kinene, it is the female's task to look for megapode eggs, thus it would be the female who would know more about the bird's behaviour, feeding or mating habits and the skills of extracting the eggs from the mounds in the ground. It would therefore be appropriate to obtain such vital information from the concerned gender so as to promote biodiversity conservation.

5.2.2.2 Teaching and learning

Teaching and learning in indigenous education is socially situated (Lave & Wenger, 1991) with learners learning through direct experiences (Simonella, 1997). The significant issues that emerged from these findings are (a) use of verbal or non-verbal instructions in indigenous education, (b) communal learning sites, and (c) use of a variety of learning approaches. Oral history emerged as the main mode of dissemination with verbal or non-verbal instructions depending on the type of activity undertaken. This is also evident in other studies such as Kawagley et al. (1998), Antone (2003) and McGregor (2004). Instructors were mostly elders who had communal responsibility towards their younger members of kin. The use of real learning venues such as gardens proved advantageous as skills training became a reality. The various teaching and learning approaches and the wide array of tools and materials used made learning more meaningful. The environment itself became

a learning tool (Kawagley et al, 1998), because learning occurred within and using it, apart from providing other materials. Given this context of teaching and learning in IE, it would be worthwhile for conservation practitioners to incorporate these approaches in their conservation awareness and education activities. Using the environment itself in teaching or talking about biodiversity may prove real for the learners as they may then be able to see its relevance in their life.

Education about indigenous knowledge (IK) unlike skills training is mainly dependent on oral history using verbal instructions, although non-verbal forms are used for instance in art and craft. IK is stored in various modes such as folk stories, folk dramas, legends, songs, dances, proverbs and myths (Fien, 2002) and is also depicted in art and rituals. Indigenous family knowledge and indigenous environmental knowledge (IEK) indicated in this study are exhibited in these forms. IK forms the basis of indigenous peoples' worldviews as they attempt to "conceptualise principles and beliefs to make sense of the world around them" (Kawagley et al, 1998; p.134). It is within these worldviews that IE attempts to develop physical, mental, emotional and spiritual capacities of the learners although it is the latter two that are developed further through education about indigenous knowledge. The implication herewith is observation of various forms of IEK may enlighten understanding of indigenous worldviews that could be incorporated to promote biodiversity conservation efforts.

5.2.2.3 Indigenous knowledge and the curriculum

The flexible, holistic and informal (McGregor, 2004; Simonella, 1998) nature of indigenous education (IE) encourages practical outdoor learning experiences that are relevant to real life situations. Although school curriculum guidelines encourage flexible contextual learning whereby teachers can use the community and the environment to teach environmental studies (Marimyas et al, 2003), the introduction of formal school systems in Kinene and Zaukave has created mixed emotions amongst elders. This is because they view true learning as occurring outdoors, not within the confinement of a classroom, and involving elders in the teaching. This is seen by elders and adults as a failure within the formal school

curriculum to incorporate indigenous environmental knowledge (IEK). There is a need to incorporate holistic teaching based on contextual learning involving elders and the environment as a learning tool. This is evident elsewhere (Kawagley et al, 1998). Moreover, an understanding of the formal school curriculum by conservation practitioners may enable them to assist teachers in conservation area schools in the planning and preparation of environment studies lessons utilising IEK. Biodiversity conservation efforts may be enhanced if all stakeholders in the community (including teachers and students) are involved in the planning and implementation of the project.

5.3 Conclusions and implications for biodiversity conservation

The following conclusions have been drawn from this study. Included are implications for biodiversity conservation

5.3.1 Indigenous environmental knowledge that may impact biodiversity conservation

An important source of environmental information possessed by Kinene and Zaukave people is indigenous family knowledge. The knowledge enables the possessors to claim land rights and clan identity which are essential in a communal society where kinship bonds and shared responsibilities are vital practices. When sole responsibility of sustainable resource management lies with the resource owners, the possibility of them misusing these privileges is great. Loss of clan lands may result if this happens.

There appears to be a need to explore clan rights and responsibilities in shared resource engagement practices to ensure continued availability of clan lands for the benefit of the future generation. This may also lead to the protection of fauna and flora on these lands.

The common environmental practices of gardening, hunting and construction in Kinene and Zaukave utilise traditional indigenous practices which align with

traditional world views (Roth & Barton, 2004 and Antone, 2003) and support sustainable practices of farming, land and resource use. The shift to alternative practices, resource use and introduced religious beliefs may be detrimental to the environment as practices may be unsustainable and have unfavourable effect on certain species.

A further exploration of alternative practices and resource use is needed to establish balance practices to prevent overuse and over harvest of natural resources as well as use of non biodegradable materials. There is also a need to identify practices that promote biodiversity conservation efforts and sustainable resource management.

The Kinene and Zaukave people demonstrate a sound understanding of their forests and its resources, both natural and physical. The loss of forest land is a threat to indigenous forest knowledge as unavailability of the forest and its resources may lead to a decline in the practice of this knowledge.

There is a need to document existing forest knowledge that maybe a useful resource for local schools and the community at large. It may also be used to promote biodiversity conservation efforts in the community.

Sustainable practices of Kinene and Zaukave people are deeply rooted in their indigenous belief systems. These evolve from indigenous spiritual knowledge or conscious environmental practices that lead to indirect or direct sustainable practices. With the introduction of alternate resource use, possibilities exist whereby indigenous belief systems linked to certain resources may decline resulting in unsustainable practices.

Actions may be necessary to catalogue various sustainable practices of the communities and opportunities given to members to identify favourable sustainable practices that promote biodiversity conservation.

The indigenous spiritual knowledge and belief systems of the Kinene and Zaukave people are fundamental in developing their worldviews and environmental attitudes and values. They are also instrumental in guiding sustainable practices. The loss of indigenous knowledge and beliefs systems may have a detrimental effect on the Kinene and Zaukave people as it may lead to the decline in their attitudes and values as well as lead to unsustainable practices.

Useful indigenous spiritual knowledge and belief systems that support biodiversity conservation and sustainable practices need to be documented for use as resource materials. Opportunities need also be given to knowledgeable elders to share this knowledge to younger members of kin through formal or informal gatherings.

The changes in resource use are motivated by both external and self imposed demands which are beneficial as well as harmful to the environment and to indigenous environmental knowledge and practices at large. Alternative resources that are beneficial are ones that contribute to minimal resource use. Those that are harmful are ones that are unsustainable and use non biodegradable materials. Use of alternative resources may contribute to loss of relevant indigenous environmental knowledge and skills and enhance unsustainable practices.

Alternative resources that are both environmentally friendly and do not affect indigenous environmental knowledge and practices need to be explored. A further action may be needed to catalogue this information so that indigenous communities may be well informed on the choices available to them.

5.3.2 Acquisition, interpretation and dissemination of indigenous environmental knowledge

The acquisition, interpretation and dissemination of IEK involve training in various relevant skills which are lifelong processes. These skills are found to be gender and age dependent and are determined by the differing gender roles within the communities. The process of skills acquisition is scattered over a person's lifetime

and is learnt at various development stages within a person's life.

With the teaching and learning of gendered and age dependent indigenous skills occurring early in a person's life, the removal of the children into the formal school system may mean the decline of these skills. There may be a need to involve elders in the teaching of these skills during art, environmental studies or health lessons.

Teaching and learning in indigenous education (IE) is socially situated (Lave & Wenger, 1991) with learners learning through direct experiences (Simoneli, 1997) through oral history by means of verbal or non-verbal instructions within communal sites such as gardens. Tools involved in teaching and learning in IE are varied and activity-dependent but range from all environmental resources to construction tools. The environment itself is also considered a teaching and learning tool (Kawagley et al, 1998) as it is directly or indirectly used throughout the process. Secondly, education about knowledge in indigenous education is dependent on oral history using verbal instructions with necessary non-verbal forms such as in art and craft. This knowledge is stored in various modes (Fien, 2002) and depicted in arts and rituals to illustrate the connectedness between the spiritual and the physical worlds.

The use of the environment as a teaching and learning tool in IE has proven to be a worthwhile experience for learners. There may be a need for teachers to plan regular outdoor lessons that may enhance student interaction with the environment. Secondly, most information, knowledge and conservation messages are contained in this form of knowledge and may need to be observed to grasp an understanding of indigenous worldviews that could be incorporated to promote biodiversity conservation. A catalogue of such information may be a useful resource for the local communities involved.

Indigenous education (IE) is flexible, holistic and informal and encourages practical outdoor learning experiences relevant to real life situations. This enables it to be integrated into the formal school curriculum which was also designed with

flexibility to enable contextual learning.

An integration of both system using teachers and elders will make learning more practical for the children. There may be a need for conservation practitioners to collaborate with local teachers to design interactive lessons incorporating IEK and environmental studies or other similar learning strands. This may enable the children to continue learning about skills and knowledge that are relevant to their daily lives.

5.4 Implication for the future

This research was a small scale case study of the role of indigenous knowledge in biodiversity conservation in two local communities. It could be useful to undertake further research into teachers' views on incorporating indigenous environmental knowledge into the formal school curriculum. Such research may establish the approaches that can and cannot work in the formal curriculum. It may also give some insight into what conservation practitioners can do to assist this process. Moreover, further research into indigenous knowledge of other areas of Papua New Guinea could also give some insight into their environmental perceptions and how this differs from this study.

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Appendix A: Interview Questions – *for elders & adults*

(all personal details will be recorded in the field notebook)

1. (a) What is the name of your tribe?
(b) Where did your tribe originate from?
(c) How long has your tribe lived in this area? What enabled your tribe to live that length of time in this area?
(d) What is your tribal totem? What is the significance of this totem?
2. (a) How important are plants, animals, rivers, mountains and the forests to you and your tribe? Why?
(b) Do you have an explanation about how these things came to be in your area?
3. (a) What are your beliefs about the uses of plants/animals?
(b) What are your beliefs about the physical environment such as rivers, mountains, caves, etc?
(c) Are there other tribal beliefs in relation to the environment? Can you give some examples? What is your view about these beliefs?
4. (a) How do you explain the existence of plants and animals in your environment? How do you know about these explanation(s)? How important are these to you and your people? Why?
(b) If you look around your environment today, would you say it is the same as the one your ancestors lived in 50 years ago? Why or why not?
(c) What has happened to it now? How do you think this would have been prevented? How do you ensure that the environment continues to provide for you and your tribe's needs?
5. (a) How do you make gardens? Why do you make your gardens like that? If you did not make your gardens like that, what would happen?

6. (a) Do people still go hunting today? How often would they go hunting?
Why?
(b) How do they know how much is needed?
7. (a) How do you construct houses or other artefacts? What materials do
you use for construction of these artefacts? Why do you use these
materials? How do you obtain each of these materials?
(b) Who constructs these artefacts? Why?
(c) How do you ensure that the environment continues to provide these
materials for your tribe?
8. What kind of skills are men taught in relation to the environment? Are there
specific skills that only men can learn? What are they?
9. What kind of skills are women taught in relation to the environment? Are
there specific skills that only women can learn? What are they?
10. When do they start learning these skills? Who teaches them and why?
11. Where does teaching and learning occur? What teaching skills are used?
12. For the different skills mentioned above, what tools are used?
13. (a) How are the instructors able to teach the participants (learners)?
(b) What do they do?

Appendix B: Interview Questions – *for teachers*

1. (a) How do you view the natural (plants &, animals) and physical (rivers, mountains & forests) environment? Why?
(b) How do you explain the existence of these things in the area? How do you know that?
2. (a) What are your beliefs about the uses of plants and animals? Are you aware of other similar views in your community?
(b) What are your beliefs about the physical environment such as rivers, mountains, caves, etc? Are you aware of other similar beliefs?
(c) Do these views influence your attitudes to the environment? How?
(d) Are there other beliefs that your people have in relation to the environment? Can you give some examples?
- 3 (a) How do the local people explain the existence of plants and animals in their environment? How did you come to know that?
(b) How important is this knowledge to the local people? Why?
(c) Are there activities carried out that emphasise this knowledge? If so, can you give some examples?
- 4 (a) Would you say that the current environment the local people live in is the same as the one their ancestors lived in 50 years ago? Why or why not?
(b) What do you think has happened? How would they have prevented this from happening?
5. What kind of gardening practices do the local people employ? If they did not do that, what would happen?
6. (a) What are the local hunting practices? How often would people go hunting? Why?
(b) How do they know how much is needed?

7. What kind of skills are children taught in relation to the environment?
8. Who teaches them these skills and when?
9. How are these skills taught?

Appendix C: Interview Questions – *for students*

1. (a) Have you heard stories about how plants and animals were formed?
Can you give some examples? How did you come to know these stories?
(b) Have you heard other stories about how different things in your environment such as mountains and rivers were made? Can you give some examples?
2. (a) Have you heard stories about how plants and animals came to be in your environment?
(b) What plants and animals from the environment are used for food? Can you give some examples? How are you able to identify these plants and animals? Who taught you these skills?
(c) What plants and animals are used for cultural ceremonies? Can you give some examples?
(d) What would happen if there were no plants and animals in your environment?
(e) How would you ensure that there are plenty of plants and animals left in your forests and rivers?
- 3 (a) If you look around your environment today, would you say it is the same one that your parents lived in when they were children? How do you know that?
(b) Do you think they should still be here? Why is that important? What could they have done differently?
4. Do you know how to make a garden? How did you learn to make one?
5. Do you know how to weave baskets/string bags or construct bows & arrows? How did you learn to make one?
6. Are there other environmentally related activities you have learnt how to do? If so, what are they? Who taught you how to do these?
7. Are there differences in how you learn about the environment at school and at home (in the village)?